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## Comparing Aggressive and Impulsive Behavior in Concussed and Non-Concussed Athletes

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Comparing Aggressive and Impulsive Behavior in Concussed and Non-Concussed Athletes

By

Jason Haddix

Accepted in Partial Completion  
of the Requirements for the Degree  
Master of Science

Kathleen L. Kitto, Dean of the Graduate School

ADVISORY COMMITTEE

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## MASTER'S THESIS

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Jason Haddix

May 12<sup>th</sup>, 2017

Comparing Aggressive and Impulsive Behavior in Concussed and Non-Concussed Athletes

A Thesis

Presented to

The Faculty of

Western Washington University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science

By

Jason Haddix

May 12<sup>th</sup>, 2017

## Abstract

The high prevalence of concussions sustained through sport involvement, particularly in contact and team sports, are great in number, roughly 1.8 to 3.6 million annually within the United States (Thurman, Branche, & Sniezek 1998). The physical symptoms that follow a concussion are well noted, but the impairment of cognitive reasoning and emotional regulation needs further research efforts. Increases in aggression and impulsivity are common symptoms of traumatic brain injuries (TBI; Rochat et al., 2010) that can affect one's standings socially and can increase the likelihood of deviant behavior that one may not normally engage in if cognitively and emotionally stable (Tateno, Jorge & Robinson, 2003). The purpose of the study is to identify levels of aggressiveness (sport and life aggression) and impulsiveness in an athletic population. The current study, was the first of its kind to assess aggressive and impulsive behavior in active athletes via an online survey. The sample consisted of 139 athletes currently involved in competition, regardless of competition season, at the recreational ( $n = 29$ ), university club ( $n = 115$ ), varsity ( $n = 20$ ), or amateur/semi-professional/professional level ( $n = 11$ ), with multiple athletes competing at multiple levels in multiple sports. Athletes were asked to complete the Bredemeier Athletic Aggression Inventory-Short Form (BAAGI-S; for sport aggression), the Buss-Perry Aggression Questionnaire (BPAQ; for life aggression), the UPPS Impulsive Behavior Scale, and a self-report criminal history survey through Qualtrics. Athletes were categorized into independent variables of concussion history (history of concussion or no history), sex (male or female), and number of concussions (single versus multiple). Scores from the questionnaires were analyzed through a multivariate analysis of variance (MANOVA). It was expected that those athletes with a history of concussion(s), would score significantly higher on measures of sport aggression, life aggression, and impulsiveness compared to a non-concussion

group. The second hypothesis was, that those who had experienced multiple concussion diagnoses would score higher on measures of sport aggression, life aggression, and impulsiveness as compared to the single concussion diagnosis group. The third hypothesis was that concussed male athletes would report higher scores on measures of sport aggression, life aggression, and impulsiveness as compared to concussed female athletes. In relation to the first hypothesis, athletes with a past history of concussion(s) did not statistically differ from athletes with no past history of concussions for sport aggression, life aggression, or impulsivity total scores,  $F(3, 134) = 1.53, p = .209, \eta_p^2 = .033$ . In addition, athletes with one medically diagnosed concussion did not statistically differ from athletes with multiple medically diagnosed concussions for sport aggression, life aggression, or impulsivity total scores,  $F(3, 50) = .33, p = .81, \eta_p^2 = .019$ . Finally, female athletes with a history of concussions did not statistically differ from male athletes with a history of concussions for sport aggression, life aggression, or impulsivity total scores,  $F(3, 83) = .07, p = .97, \eta_p^2 = .063$ . Additionally, a descriptive report was performed, which assessed pre and post-concussion violent criminal history for the athletes based on arrests, charges, and convictions of violent crimes. Of the 88 athletes (63.3%) with a concussion history, two athletes (2.7%) reported engagement in aggressive criminal behavior *after* their first concussion. In conclusion, the proposed study did not identify any statistical difference between the group comparisons for the dependent variables, however, anecdotal responses provided by a small number of athletes helped identify the athletes' possible lingering emotional and/or behavioral symptoms following a concussion.

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## **Chapter I**

### **Introduction**

The prevalence of mild traumatic brain injuries (mTBI) in contact sport athletes has resulted in extensive research on physical symptoms and rate of recovery (Baugh et al., 2012; Bernick et al., 2015; Gardner & Yaffe, 2015; Guskiewicz et al., 2005; Ling, Hardy & Zetterberg, 2015). However, within past research, less emphasis has been placed on the possible emotional symptoms that could arise for an athlete who has suffered from a mTBI (Mainwaring, Hutchison, Bisschop, Comper, & Richards, 2010). Previous research findings showed a possible increase in aggression and impulsive behaviors following a mTBI (Dyer, Bell, McCann, & Rauch, 2006; Rochat et al., 2010; Tateno et al., 2003). These increased emotions have been correlated to damage done to the executive functioning and emotion regulation processing centers of the brain (Siever, 2008). With the increased risk of concussions in contact sports, particularly American football (Guskiewicz et al., 2003), it is important to note all side effects of brain injuries, including their duration and persistent states, so that there is awareness of all known risks of such injuries (Ling et al., 2015). The goal of the current research was to identify athletes' current emotional states and assess whether or not a previous occurrence of a concussion differentiated reports of dysfunctional emotional behavior (e.g., antisocial behavior, hostile aggression, impulsive aggression, increased impulsivity, and risk-taking).

### **Purpose of the Study**

The objective of the present study is to examine whether or not there are differences in aggressive and impulsive behaviors for those athletes previous diagnosed or self-diagnosed with mTBI when compared to athletes with no previous history of concussion. In addition, due to the increased susceptibility to additional concussions following the occurrence of an initial

concussion (Guskiewicz et al., 2003), an exploratory analysis compared the differences between aggressive and impulsive behavior among athletes with multiple medically diagnosed concussions to athletes with only one medically diagnosed concussion. Next, male and female athletes with a history of concussion(s) were compared on scores of sport aggression, life aggression, and impulsivity. Finally, aggressive criminal history following the occurrence of a concussion was assessed due to past research indicating that impulsivity and aggression are positively associated to deviant behavior (Rochat et al., 2010).

### **Hypotheses**

It was expected that athletes with a history of concussion(s), either diagnosed or self-diagnosed, would score significantly higher on the Buss-Perry Aggression Questionnaire (BPAQ; Buss & Perry, 1992), the Bredemeier Athletic Aggression Inventory-Short Form (BAAGI-S; Bredemeier, 1975) and the Urgency, Premeditation, Perseverance, Sensation Impulsive Behavior Scale (UPPS; Whiteside & Lynam, 2001) compared to a non-concussion group. The second hypothesis was that those who had experienced multiple medically diagnosed concussions would score higher on the BPAQ, the BAAGI-S, and the UPPS as compared to the single medically diagnosed concussion group. The third hypothesis is that concussed male athletes reported higher scores on the BPAQ, the BAAGI-S, and the UPPS compared to concussed female athletes. The null hypothesis would be accepted if there is no difference between the concussion group assessments and/or the gender comparison groups on the BPAQ, the BAAGI-S, and the UPPS.

### **Significance of the Study**

This study's intentions are to evaluate the current differences between the instances of aggression, both life and sport, in athletes with a history of concussion(s) and no concussions.

Further, the differences found between impulsivity and athletes with or without a history of concussion(s), would provide another level of dimension regarding emotional responses and the decision-making ability of the athletes in instances of sport and life (Banks et al., 2014). In addition, this would be the first time each of these emotional assessments (impulsivity, life aggression, and sport aggression) have been examined together to report the emotional states of concussed and non-concussed athletes. Finally, a possible identification may be made between the occurrence of a concussion and its possible influence on deviant and/or illegal behavior within the active athlete population. Upon final evaluation of the study, there was a better understanding of the prevalence of aggressive and impulsive behaviors for athletes who have suffered a mTBI when compared to non-concussed athletes. If there is an increase in aggressive and impulsive behavior following the occurrence of a concussion diagnosis, then post-concussion rehabilitation specialists should also focus on emotional and cognitive rehabilitation to supplement physical rehabilitation. In addition, a comparison was made regarding whether an athlete with multiple concussion diagnoses showed an increase in aggression and impulsivity scores as compared to an athlete(s) with one concussion diagnosis, due to the possible culminating cognitive and emotional affect multiple concussions can have on an athlete. The current study would be the first to exam whether active athletes with multiple medically diagnosed concussions report greater emotional and/or behavioral dysfunction compared to athletes with a single medically diagnosed concussion in active athletes.

### **Limitations of the Study**

The following limitations were identified upon the conclusion of the study.

1. A concussion diagnosis cannot be confirmed, due to the self-report nature of the study.
2. The degree/severity of concussion diagnoses cannot be confirmed, due to self-report.

3. The length of time since concussion diagnosis varied within the sample population.
4. Due to the individual variability of each concussion, there were differences in recovery time and symptom expression, which may have affected the responses to the dependent variables of life aggression, sport aggression, and impulsivity.
5. If a limited amount of athletes in each particular sports responds, then the results of the study may not be applicable to all sports, hence affecting external validity.
6. The study population consisted of a convenience sample.
7. There could have been a possible social desirable response bias for the measurements of aggression and impulsivity.

### **Definition of Terms**

**Mild TBI/Concussion:** A mild traumatic brain injury (mTBI)/concussion is defined as “a blow to the head that causes a variety of symptoms that may last for a short period of time, such as a few plays or minutes of a game, or a longer period of time” (Fraas, Coughlan, Hart, & McCarthy, 2014). “These symptoms may include any of the following: headache, difficulty concentrating or focusing, feeling slowed down, dizziness or balance problems, nausea, fatigue, feeling dazed, drowsiness, forgetting things, sensitivity to light, loss of balance, sensitivity to noise, and blurred vision. In addition, it is important to realize that a concussion can occur without being “knocked out”, experiencing unconsciousness, and/or feeling “dazed” is a concussion” (Fraas et al., 2014).

**Impulsivity:** Impulsivity is defined as the reaction to stimuli that shows urgency, lack of reflective thinking, lack of commitment, and active sensation seeking (Whiteside & Lynam, 2001).

**Life Aggression:** Life aggression is defined as acts of physical confrontation, verbal confrontation, hostility, and anger (Buss & Perry, 1992).



**Sport Aggression:** Sport aggression is defined as acts of hostile/reactive or instrumental aggression, which occur within the context of sport. An example of hostile aggression, is engaging in the act of physical aggression with the intent to hurt an individual. An example of instrumental aggression, is engaging in the act of physical aggression with the intent to gain a competitive edge of an opponent (Bredemeier, 1975).

**Contact sports:** Contact sports were defined in the present study as traditional team sports where physical force is used, against an opponent, as a strategic means of overcoming an obstacle or progressing through a game; such sports include football, rugby, and hockey (Kerr, 2008).

**Second Impact Syndrome:** Second impact syndrome is a medical term used to classify sustaining a second concussion before the symptoms of the first concussion subside (Ling et al., 2015).

**Scheme:** A scheme is a “system of knowledge or beliefs about environmental and interpersonal behavior stored in long-term memory” (Singer & Salovey, 1991). Similarly, “specific beliefs based on automated scripts and action plans that facilitate efficient performance of the behavior selected” (Abelson & Schank, 1977).

## **Chapter II**

### **Literature Review**

#### **Introduction**

The physical symptoms that follow a concussion have been thoroughly described in past research (Bernick et al., 2015; Gardner & Yaffe, 2015; Guskiewicz et al., 2005). However, there is need for supplemental research on the effects that concussions have on cognitive impairment and emotional regulation (Ling et al., 2015; Mainwaring et al., 2010). It is important to treat not only the physical impairments of concussion, but also the subsequent emotional effects to help increase overall well-being (Ling et al., 2015). Increases in aggression and impulsivity are possible symptoms that can follow a traumatic brain injury (mTBI). In addition, the presence of aggression and impulsivity can increase the likelihood that the individual may engage in deviant behavior that one may not normally engage in if mentally stable (Dyer et al., 2006; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001).

To better explain how conscious behaviors occur, Bandura's social-cognitive theory of moral thought and action explains that our behaviors are influenced by our moral beliefs (Bandura, 1999). Further, Bandura theorized that the act of contemplating aggressive or antisocial behavior results in anticipatory guilt, thus reducing the engagement in antisocial behavior (Bandura, 1999). Two questions raised by neurologists and other researchers, does the occurrence of a mTBI influence our tendencies to bypass our morals and allow the individual the ability to engage in antisocial behaviors and is this ability related to the resulting cognitive impairment of the injury? In addition to emotional processing, can present levels of impulsiveness affect the time needed, by the individual, to respond to stimuli appropriately and process the potential outcomes? By addressing the previous questions, researchers have a better

understanding of how the processing and control regions of the brain, the frontal cortex and the amygdala, respond to the negative effects of a mTBI and process subsequent behavioral interactions in both sport (Banks et al., 2014; Mainwaring et al., 2010) and life (Dyer et al., 2006; Tateno et al., 2003; Till et al., 2008).

The following literature review contains information regarding the pathology and occurrence of aggression and impulsiveness in athletes who may or may not have a history of past mild-traumatic brain injuries. In addition, the following research may have helped validate the hypothesis that a mTBI can influence the emotional and behavioral responses of athletes in both life and sport.

**Mild traumatic brain injury (mTBI) classification and identification.** A mild traumatic brain injury, commonly referred to as a concussion, occurs following a direct blow to the head, face, neck, or body, which results in an impulsive force directed to the head (McCrory et al., 2013). In addition, a concussion is identified as a low velocity injury that causes the brain to shake within the skull, which results in clinical symptoms (McCrory et al., 2013). The inertia following the impulsive force applied to the brain, often effects the frontal lobe and temporal poles (Broglia et al., 2010; McCrory et al., 2013). An evaluation of the severity and symptoms following a mTBI helps determine the nature of the injury. The occurrence of the sudden impact on a cellular level can result in hemorrhaging and stretching of blood vessels, neurons, and glial cells; however, such occurrences are rare (Broglia et al., 2010; Ling et al., 2015). Baugh et al. (2012) noted that cognitive and physical effects of concussions were longer lasting if sustained early in development. Researchers reported that non-invasive methods such as positron emission tomography (PET) and (fMRI) scans generally reveal the appearance of metabolic abnormalities within the frontal and temporal cortices, the medial temporal lobe (primarily the amygdala), and

the orbitofrontal regions of the brain, which are portions of the brain often effected by a concussion (Giza & Hovda, 2001; Ptito et al., 2007). The result of such metabolic disturbances often cause a neurometabolic cascade that influences proper functioning and cognitive performance. In the sequence of events leading up to medical evaluation, the acute symptomology of a concussion can be used as precautionary signal for future medical evaluations and/or concussion diagnosis (Cantu, 1996; McCrory et al., 2009; McCrory et al., 2013).

Previously, concussions have been graded on a scale depending on severity. A medical diagnosis that is often used to grade the level of a concussion is the Glasgow Coma Scale (GCS; Healey et al., 2003). Medical professionals use the grading scale score of GCS (3 - 15) to classify the severity of the TBI (Healey et al., 2003). Medically, TBIs are classed under grades I, II or III under the GCS (Healey et al., 2003). Often, the GCS grading scale is based on objective measures, which are used to determine neurological functioning, based on structural damage and the presence of acute symptomology (Gardner & Yaffe, 2015; Ling, Hardy & Zetterberg, 2015). However, as medical interventions have improved, researchers and medical professionals have turned away from the identification of structural damage, often found in severe TBIs, towards the recognition of cellular function when trying to identify mild concussions (McCrory et al., 2009; McCrory et al., 2013). McCrory et al. (2009) reported the difficulty in identifying changes in the brain at the cortical level through MRI and CT scans, however, reported success in identifying differences in metabolic functioning at the cellular level through fMRI and PET scans. Such changes in metabolic functioning are used to identify functional change (damage) in the brain that signifies the occurrence of a concussion (McCrory et al., 2009; McCrory et al., 2013). Such findings have helped signify the use of H-Magnetic Resonance Spectroscopy (MRS) scans,

which monitor the metabolic functioning of the brain (Vagnozzi et al., 2007). Through the use of the MRS, research and medical professionals have the ability to progressively assess the metabolic changes in the brain and chart the progress of the individual during recovery from a TBI (McCrory et al., 2009; McCrory et al., 2013).

As mentioned previously, the identification and assessment of acute symptoms plays an important role in both on-field assessment and medical intervention (McCrory et al., 2009; McCrory et al., 2013). There are a variety of acute symptoms that occur with mTBIs. The more overt and often self-reported acute cognitive symptoms of a concussion are confusion, disorientation, and amnesia following the incident (Gardner & Yaffe, 2015). More severe symptoms can include a loss of consciousness for up to thirty minutes or less and seizures (Gardner & Yaffe, 2015). Additional acute physical symptoms following a concussion are nausea, sensitivity to light, headache, fatigue (Guskiewicz et al., 2005), and difficulties with equilibrium and vision (Bernick et al., 2015).

With medical intervention leaning away from assessing structural damage, medical professionals, including on-field medical staff, focus more on symptom assessment (McCrory et al., 2009; McCrory et al., 2013). Post-concussion assessments are used to detect different types of subsequent impairments, both cognitive and gross motor (Guskiewicz, Riemann, Perrin, & Nashner, 1997; McCrory et al., 2009; McCrory et al., 2013). Such neurostatus assessments used by side-line medical teams include the Standardized Assessment for Concussion (SAC; McCrea et al., 1998) and the Sideline Concussion Assessment Tool II (SCATII; McCrory et al., 2009) can be used in combination with balance testing, such as the Balance Error Scoring System (BESS; Riemann & Guskiewicz, 2000) to measure both cognitive and gross motor impairment. These assessments are often used by primary caregivers assessing a possible concussion and can

be used in addition to medical intervention by providing current symptomology for further assessments and evaluations (Broglia et al., 2010).

A current issue within sport is the return-to-play protocol (McCrory et al., 2009; McCrory et al., 2013). If an athlete were to return to play before becoming asymptomatic, it can put the athlete at an increased risk for second impact syndrome (Ling et al., 2015). Second impact syndrome results when a person sustains a subsequent mTBI before the alleviation of acute symptoms from the first mTBI, which can prove to be fatal due to intracranial hemorrhaging (Ling et al., 2015). Based on the severity and culminating effects of acute mTBI symptoms, one concussive experience can be quite debilitating for the individual. Individuals can experience persisting acute symptoms of the resulting concussion ranging from 3 hours, 24 hours, 5 days or 7 days post-injury before the individual is asymptomatic (Guskiewicz et al., 2003). As Giza and Hovda (2001) stated, the continually present symptoms have a cascading effect that remains present as the brain attempts to return to equilibrium. Despite the presence and continual use of the GCS, the evaluation of a concussion by researchers and medical professionals has shifted focus towards symptomology and neural cell functioning, over the identification of brain damage.

Recently, researchers have discovered a new disease, Chronic Traumatic Encephalopathy (CTE), which has a high prevalence in individuals who have sustained multiple concussions over a performance career. CTE is a neurodegenerative disease similar to Alzheimer's disease (AD), often sharing similar biochemical markers, motor, and neurological symptoms (Gardner & Yaffe, 2015; McKee et al., 2009). Contact sport athletes such as boxers and football players who suffer from repeated mild TBIs have been identified in previous research to be at an increased risk for the disease, with 17% of athletes receiving an eventual diagnosis of CTE (Gardner & Yaffe,

2015; McKee et al., 2009). Early anecdotal evidence of the presence of CTE has been observed within the sport of boxing. The term “Punch Drunk” is generally associated with boxers who developed chronic neurological deficits from acute trauma sustained from repeated blows to the head, causing sub-concussive trauma (Gardner & Yaffe, 2015; McKee et al., 2009). The sport of boxing has a higher rate of diagnosable concussions due to the athletes’ intent to “knock-out” their opponents, often sending them into an unconscious state (Banks et al., 2014).

As previously stated, the symptomology of CTE is similar to the symptoms found in Alzheimer’s disease and dementia (Gardner & Yaffe, 2015; McKee et al., 2009). Additionally, the motor symptoms of CTE tend to reflect those of Parkinson’s disease with individuals showing body tremors, irregular gait, and unsteady posture (Daneshvar, Goldstein, Kiernan, Stein, & McKee, 2015; McKee et al., 2009). Presenting neurological symptoms that generally take place include the deterioration of attention, concentration, and memory, which are related to Alzheimer’s disease and dementia. In addition, such symptoms can impede the decision making ability causing emotional and behavior symptoms that include: poor judgement, poor impulse control, irritability, and aggressive/violent outbursts (McKee et al., 2009). Such deficits and degradation of mental health have been linked to atrophy of the amygdala, hippocampus, and hypothalamus and enlargement of the frontal lobes. McKee et al. (2009) speculated that the atypical size of these regions, referred to as the emotional and the executive functioning portions of the brain, are related to the reported cognitive and emotional dysfunction in the retired athletes. Such trauma can be related to early sublethal trauma that can occur well before the development of clinical symptoms (McKee et al., 2009). A feature of CTE is that the disease is progressive. McKee and colleagues (2009) reported that long after the initial trauma has occurred, symptoms tend to progress. The deficits in neural and motor functions tend to progress

in a cascading effect that continues over the course of the individual's lifetime (McKee et al., 2009). More severe neurodegeneration is related to the individual's age and if the individual continues to be subjected to repetitive trauma (McKee et al., 2009).

The primary shortcoming of understanding CTE is that a full diagnosis can only be achieved through autopsy (Gardner & Yaffe, 2015; McKee et al., 2009). The present limitation in the diagnosis of CTE prevents definitely knowing the cause and effect association between mTBIs and the development of CTE (Gardner & Yaffe, 2015). In addition, presenting symptoms often occur years after the athlete has retired from sport (McKee et al., 2009). Sadly, a number of the athletes later diagnosed with CTE die tragically, either from suicide, police intervention, or self-inflicted wounds (McKee et al., 2009).

In addition to the CTE related research performed by Gardner and Yaffe (2015) and McKee et al. (2009), Baugh et al. (2012) and McKee et al. (2009) reported similar findings in their study of CTE diagnosed athletes, which included previous accounts of Alzheimer's disease and dementia like symptomology. They found that those later diagnosed with CTE presented noticeable symptomology of cognitive and behavioral impairments as the disease progressed (Baugh et al., 2012; McKee et al., 2009). Further, it appeared that as the disease progressed, former athletes had symptoms of diminished cognitive functioning (executive dysfunction and memory impairment), abnormal mood (irritability and suicidality), and dysfunctional behavior (poor impulse control and aggressive tendencies; Baugh et al., 2012; McKee et al., 2009). Similarly, both Baugh et al. (2012) and McKee et al. (2009) noted on the physiological level that those later diagnosed with CTE showed reduced brain weight and atrophy of the frontal and temporal cortices, including the medial temporal lobe. Baugh et al. (2012) attributed these physiological changes in the brain, as possibly related to the chronic effect that mTBIs have on



the brain long term. Additionally, McKee et al. (2009) reported that the severity of the disorder is correlated with the number of years playing the sport and the number of mTBIs sustained throughout the playing career.

With the shortcoming of CTE diagnosis, assessments like the Short Form Health Survey (SF-36; Ware & Sherbourne, 1992), which evaluates an individual's current functional health and general well-being, may be a helpful self-report questionnaire to assess general physical and mental well-being of individuals with a past history of mTBI (Ware & Sherbourne, 1992). Through the use of the SF-36 assessment, Guskiewicz et al. (2005) was able to assess the presence of mild cognitive impairment (MCI) and symptoms relatable to Alzheimer's Disease that were noted in the retired athlete's pre-CTE diagnosis symptomology (Daneshvar et al., 2015; Gardner & Yaffe, 2015; McKee et al., 2009). Guskiewicz et al. (2005) administered the SF-36 on a group of NFL retirees (N = 2552), who had experienced concussions, to assess functional daily life (Guskiewicz et al., 2005). The SF-36 test was used by evaluators to score general health factors such as physical health, physical role limitations, experience of pain, and physical functions (Guskiewicz et al., 2005). The evaluators used a factor analysis of the SF-36 to assess scores on general mental health categories such as vitality, social functioning, and mental functioning (Guskiewicz et al., 2005). The results indicated that former NFL athletes who had been subjected to repeated subconcussive head trauma or multiple diagnosed concussions were three times more likely to develop Alzheimer's Disease like symptoms and to experience mild cognitive impairment, commonly expressed as memory impairment and cognitive decline (Guskiewicz et al., 2005). Over the course of their playing career, 60.8% of the retired athletes sustained at least one concussion, while another 24% reported at least three or more concussions. In addition, 17.6 % of the retired players who reported at least one concussion perceived that

their mTBI permanently effected their thinking and memory skills as they aged (Guskiewicz et al., 2005). Similar to the Baugh et al. (2012) and McKee et al.'s (2009) findings, Guskiewicz et al.'s (2005) retired athletes experienced persisting and accumulating effects of cognitive impairment, MCI and Alzheimer's Disease like symptoms, long after their playing days were over. However, due to the diagnostic shortcoming and still unknown knowledge relating to the development and progression of CTE, assessments like the SF-36 may be used as a possible screening measure by researchers to help further the knowledge of CTE.

**Prevalence and recovery from mTBI.** The prevalence of concussions is 100-200 cases per 100,000 individuals who seek medical attention annually (Gardner & Yaffe, 2015). In regards to contact sports, Thurman et al. (1998) reported 1.6 to 3.8 million concussions occur annually in the United States alone. Information regarding why concussions go underreported, specifically in sports, typically varies based on coaches' and athletes' knowledge and inclination to report (Broglia et al., 2010). Broglia and colleagues (2010) noticed that for coaches, underreporting was due to the lack of education in identifying concussions on the field of play. Broglia and colleagues (2010) reported that coaches still believe that the predominant sign of a concussion involves the athlete losing consciousness after a hit, which only happens in about 10% of all cases. In the case of athletes, Broglia and colleagues (2010) reported that of the 29 athletes who sustained a concussion over the season, 18 athletes did not report their injury to either coaches, medical staff, or legal guardian. When asked for the rational for concealing their concussions, the athletes either reported that "the injury was not serious (n = 16, 72.7%), not knowing it was a concussion (n = 4, 18.2%), not wanting to let the team down (n = 1, 4.5%), and/or believing that concussions are part of the game (n = 1, 4.5%)" (Broglia et al., 2010). Fraas et al. (2014) found similar results in rugby union players, who over the course of a competitive

season only self-reported 45% of concussions received during the season to either team members, coaches, medical staff, or others (parents).

When tracking the prevalence rate of concussions, common diagnoses of mild to severe TBIs are typically experienced following vehicular collisions, domestic abuse, military combat, and collisions experienced in contact sports such as football, hockey, combative arts (MMA, kickboxing, and boxing) and non-contact sports such as soccer and baseball (Gardner & Yaffe, 2015). Ironically, with improvements in protective sport equipment, specifically in American football, the increased body padding and protective headgear are thought to increase the athlete's sense of personal safety, thus leading to increased risk taking and higher reports of concussions (Cantu, 1996). With such high numbers of concussion occurring annually, it is important to also understand when athletes are the most susceptible to experiencing concussion.

The following research performed by Guskiewicz et al. (1997; 2003) and Collins, Lovell, Iverson, Cantu, Maroon, & Field (2002) tracked the prevalence rates, duration, and sport specific occurrence of concussion. When tracking the occurrence rates of concussion in high school athletes, Guskiewicz et al. (2003) and Collins et al. (2002) reported that first occurrence of a concussion increased the likelihood of that athlete suffering another concussion within the same season. Athletes who reported three or more concussions sustained throughout a playing career are three times more likely to suffer another concussion that season (Guskiewicz et al., 2003). The prevalence of reoccurrence was 35% for those who have had a previous concussion during their playing careers (Guskiewicz et al., 2003). Guskiewicz et al. (2003) determined that if an athlete experienced the reoccurrence of a concussion during the same season, 91.7% occurred within 7-10 days of the first concussion. Similar result by Collins et al. (2002) were that those athletes who had sustained up to three concussions over a playing career were nine times more

likely to suffer a concussion within a playing season compared to their fellow high school athletes who had no prior diagnosis of concussion. Collins et al. (2002), attributed the increased likelihood of reoccurrence to the culminating effect that concussions have on an individual, which can lead to a lower threshold needed to sustain a concussion. Additionally, Guskiewicz et al. (2003) reported on contact sports, primarily football, to have the highest rates of concussion and repeat concussion diagnoses for high school athletes.

Physiologically, Guskiewicz et al. (1997) wanted to address what put a concussed athlete at such a higher rate of reoccurrence. When comparing the acute symptoms of recently concussed athletes, Guskiewicz et al. (1997) reported that athletes who had not regained full postural control were at an increased risk to sustain another concussion. The subsequent concussion was likely due to the athlete's poor control over gross body mechanics in practice leading to improper technique. Guskiewicz (1997) reported that many collegiate return-to-play protocols did not fully assess physiological measures of gross motor movement or postural control post injury, which can persist up to 10 days post-injury (Guskiewicz et al., 1997). Collins et al. (2002) reported that concussions present a wide variance in symptom expression and recovery time for each athlete. The following research on concussion reoccurrence has led to the development of and emphasis on strict return-to-play protocols over the past decade (Ling et al., 2015).

When trying to determine the window of recovery for a concussion, it is important to note the severity and duration of experienced symptoms (Ling et al., 2015). Ling et al. (2015) reported that the acute effects of a concussion generally are resolved within 7-10 days for 80-90% of individuals. Longer lasting chronic effects of concussions, also known as post concussive syndrome (PCS), can persist in 40-80% of individuals experiencing symptoms lasting up to three

months and, in rare occasions, up to one year (Ling et al., 2015). The persistent neurological symptoms can include “headache, dizziness, impaired attention, poor memory, executive dysfunction, irritability, and depression” (Ling et al., 2015). Ling et al. (2015) determined, through MRS, that neurometabolic and neurological disturbances from the initial concussion could take up to 30-45 days to return to baseline levels even after acute symptoms have ceased. Furthermore, longitudinal studies have shown that concussed individuals reported a decline in baseline cognitive functioning measurements following 12-month reevaluation intervals (Till et al., 2008). The only instance of intervention-based improvements in cognitive functioning was experienced by the individuals who adhered to the cognitive rehabilitation within five months post-injury (Till et al., 2008). Those individuals experienced improvement in overall cognitive functioning from intake to the conclusion of the 12-month assessment (Till et al., 2008).

Further research on the presenting and lasting effects of a concussion can allow for a better understanding of the severity of each injury and the possible effects multiple concussions have on the individual. This, in turn, allows for improved identification of the physiological and mental acute effects that require treatment (Ling et al., 2015). Information obtained from future research may be used to educate the public about the risk factors that may result from sport involvement, particularly in contact-related sports.

### **Cognitive and Emotional Regulation Theories**

**Social-cognitive theory of moral thought and action.** To provide a further explanation for engaging in aggression and impulsiveness, psychological theory was used to provide the basis for further concept integration. Different theories explain the development of moral reasoning by helping to identify the primary drive for social interaction and the formation of social behavior. The social-cognitive theory was developed as an explanation of how an

individual developed moral reasoning (Bandura, 1999). Bandura (1999) explained that the formation of moral development begins at an early age and continually grows and builds upon its initial schemes, which are described as mental reference points stored within memory. Bandura's explanation of the growth, transitioning, and development of morality emphasizes a continuum of growth as the individual transitions through the stages of moral development. Bandura (1999) believed that the three constant sources of moral influence are behavioral, cognitive, and environmental influences. These three sources of moral development continually interact and influence the individual's formation of morality (Bandura, 1999). Even though our behaviors and morals are largely influenced and formed by others, each individual has the final decision on how he or she acts (Bandura, 1999).

The initial social cognitive interactions that take place in the developmental stages of youth are based on intrapersonal needs or wants of the child, like attention, soothing, or hunger (Bandura, 1999). These initial social interactions, identified as the drive-to-perform, are expressed as the motivating drive for a younger individual, which are primarily based on self-satisfaction and need fulfillment (Bandura, 1999). When individuals age and mature through life experiences, the social aspect of life becomes the initiating factor for moral development. For children in the initial stages of moral development, the primary caregivers become influential in shaping the values, setting moral standards, and modeling the appropriate behavior expected of the child for each particular social situation. The original parental values are then adapted through the modeling of others: including siblings, peers, other adults, and even institutions that create and enforce the standard norms of behavior for particular social situations. Bandura (1999) explained, that social learning continuously adapts long after the initial stages of cognitive development. Only as individuals are exposed to more diverse social situations does this

involvement allow for the development of broad or more specialized moral development (Bandura, 1999).

Bandura (1999) based the moral development stages on the stage theory of moral reasoning, initially developed by Piaget (1965) and expanded by Kohlberg (1971), which serves as the structural basis of one's morality. Kohlberg's (1971) six stages of moral rule appear to follow a sequential process: "punishment-based obedience, opportunistic self-interest, approval-seeking conformity, respect for authority, contractual legalistic observance, and collective principles based on justice" (Kohlberg, 1971). When transitioning through each stage, the individual begins to see how established institutions like schools and government create standards that, in turn, influence behavior. These institutions are then governed by authority figures who act as models of ideal moral behavior (Kohlberg, 1971).

In keeping with Kohlberg's (1971) theory, Bandura (1999) explained that later in life the individual continues to experience new morally conflicting events and that each response to such event can further influence the individual's development of morality. In addition, the desire for conformity and approval seeking reflects the influence peers and authority figures have on our moral development (Bandura, 1999). According to Bandura (1999), the indication of self-interest is the always-present factor driving our behavior. An individual's morals act as self-governing agents, promoting behaviors that increase the sense of self-satisfaction and self-worth, while rejecting behaviors that violate others' rights that would produce a distressing experience of shame and guilt (Bandura, 1999). Researchers have discussed why people behave in a prosocial manner, described as voluntary acts towards others that help or benefit the recipient(s), which reflect the general principles of morality (Boardley & Kavussanu, 2009). On the other hand,

there are instances that occur in one's moral development that allow an individual to voluntarily act in a manner that personally violates another's rights.

According to Bandura (1999), the following steps taken by the individual, allows him/her the ability to disregard feelings of morality through moral disengagement. The act of moral disengagement is the self-selected inhibition of morality, which allows the individual to justify the use of antisocial behavior as purposeful behavior (Bandura, 1999). Upon moral disengagement, the individual's resulting behavior intentionally harms or disadvantages another person, while benefitting the acting individual (Bandura, 1999). When one's morals come in conflict with the ability to receive personal satisfaction, one tends to employ moral disengagement to reduce the experience of negative emotions, which proceed antisocial behavior (Bandura, 1999). Bandura (1999) noted the following changes in cognition that allow an individual to cope with his or her resulting negative emotions: devaluating the victim, blaming, disregarding or misrepresenting injury, and retaliation towards wrongdoing. Through personal justification, the inhibition of morality and the use of moral disengagement can prove to be an adaptive means for justifying antisocial behavior (Bandura, 1999).

Assuming that a mTBI results in impairment of decision-making skills and impulse control (which includes expressed behavioral, emotional, and cognitive deficiencies) a concussed individual is possibly more likely to experience disruption in his or her moral decision making as well (Baugh et al., 2012). Examples of such impairments include diminished cognitive functioning (executive dysfunction and memory impairment), abnormal mood (irritability and confusion), and inappropriate behavior (poor impulse control and aggressive tendencies; Baugh et al., 2012). Overall, the culminating effect of each impairment can in turn result in socially



abnormal behavior deemed as aggressive, risky, and/or impulsive (Baugh et al., 2012) and not reflecting the moral-self through prosocial behaviors described by Bandura (1999).

**Aggression: Theories, definitions, and pathology.** Aggression is a broad category that includes many overt acts deemed hostile, injurious, or destructive in nature (Siever, 2008).

Aggression, a socially negative behavior, is characterized in the context of psychopathology as a lack of empathy for others coinciding with antisocial behavior (Siever, 2008). Aggressiveness is the disposition to respond aggressively or engage in aggressive behavior (Siever, 2008). Anger and aggressiveness were identified as the antecedents of aggression (Berkowitz, 1993). When aggressive symptoms coincide with increased emotional sensitivity and dysregulation, acts of impulsive aggression could be pathologized with particular psychiatric disorders like anti-social personality disorder (Siever, 2008). In order to classify an act as aggressive, one should consider the circumstances of its occurrence and the rationale behind the response. An aggressive act can be classified as either premeditated or impulsive (Siever, 2008). The behavioral responses of premeditated aggression are generally not quick reaction responses to stimuli, but are planned behaviors with the direct motive of causing harm (Siever, 2008). However, impulsive aggression, an immediate response, usually occurs when an individual experiences frustration through a situational event deemed threatening (Siever, 2008). In addition, the mode of aggressive behavior can be situationally based (Bredemeier, 1985). Particular instances of situational aggression can occur as either hostile or reactive aggression (intent to harm) or instrumental aggression (harm is byproduct of goal pursuit; Bredemeier, 1985). Under the context of hostile/reactive aggression, aggressive behavior can result in retaliation against others who have wronged the acting individual (Bredemeier, 1985). Sport related examples of hostile aggression include a purposeful “hard hit” with the intent to injure or targeting an injured athlete (Silva &

Conroy, 1980). In addition, instrumental aggression is intentional aggressive behavior used to obtain a competitive advantage over an opponent, such as a slide tackle in soccer, or intentionally fouling in basketball. The engagement in instrumental aggression may not always result in physical harm to an opponent, but may be the byproduct of the behavior (Silva & Conroy, 1980). Those recently suffering from a concussion tend to demonstrate higher instances of particular emotional abnormalities, like increased anger and inability to regulate aggression (Dyer, et al., 2006). It could be that athletes with a history of mTBI tend to have more sport hostile and instrumental aggression than athletes without a mTBI. The discussion of this literature review focuses primarily on athletes' impulsive/direct response to aggression, the rationale behind impulsive aggressive behavior, and what increases the likelihood of this response.

Through studying the pathology of aggression, researchers have a better understanding of how the brain deciphers whether a presenting stimulus should result in aggressive or defensive behavior. The presented stimuli that triggers the evaluation of aggression are received in the orbital frontal cortex (OFC) and anterior cingulate cortex (ACC), which are also identified as the executive reasoning portions of the brain (Greve, Love, Sherwin, Stanford, Mathias, & Houston, 2002). The OFC then perceives the possible threat by evaluating the presenting verbal/non-verbal cues, and then considers the following response possibilities, which are based on previous rewards or punishments (Siever, 2008). The amygdala, known for the fight or flight response, relays the message from the OFC and ACC, and initiates the response resulting in the physical act of aggression if the threat is deemed valid (Siever, 2008). Aggression, even though not regularly deemed a socially desirable response, has its system of checks and balances in the OFC and ACC to help decipher if the response is appropriate (Greve et al., 2002). However, if either

the executive reasoning (decision-making) region of the brain, or the action region of the brain, the amygdala, were to experience damage from direct trauma, it would likely increase the response of aggressive acts or emotional disturbance (Siever, 2008). When the OFC and/or ACC experiences damage, the individual tends to demonstrate noticeable impairment in active problem solving, emotional stability, social behavior, and self-awareness of actions (Siever, 2008). The impaired ability to problem solve can increase the likelihood of impulsiveness and violent action (Stoddard & Zimmerman, 2011). Siever (2008) noted through MRI scanning that those with antisocial personality disorder tend to show hyperactivity or damage to the OFC, ACC, or the amygdala, resulting in a general increase in threat detection. The increased numbers in threat detection tend to lead to highly deviant behavior (Siever, 2008) and could explain the changes in impulsivity following trauma to the region. The pathology of aggression has led to a greater understanding of the occurrence and regulation of aggression. However, there is a need for recording and measuring purposes in order to explain the frequency and classification of each mode of aggressive behavior.

**Aggression: Theoretical applications to sport.** Within the context of sport, particularly in contact and team based sports, certain acts justified by the athlete take place both legally and illegally, which are deemed aggressive outside the context of sports (Bredemeier, 1985). Examples include tackling, intentionally fouling, and positioning oneself to cover and immobilize the opponent. These actions, if done properly, are acceptable and expected as part of the game (Kerr, 2008). These aggressive actions are reflected as socially acceptable responses generally used to influence the outcome of the game and are reflected through positive reinforcement of others related to the sport (Boardley & Kavussanu, 2007). Typically, when the arousal and the anxiety provoking stimuli related to the game increases, observers see athletes

intentionally perform harmful acts directed towards other players (Sage & Eitzen, 2013). Plays referred to as “hard hits” or plays that are used to deliberately harm another athlete to gain competitive advantage, an example of hostile aggression, commonly take place in the culture of sport (Silva & Conroy, 1980).

When athletes engage in overtly aggressive play, most aggressors use a form of moral disengagement (Bredemeier, 1985). As explained by Bandura (1999), common techniques of moral disengagement include devaluating the victim, blaming, disregarding or misrepresenting injury, and retaliation towards wrongdoing (Bandura, 1999). Through the use of moral disengagement, athletes are able to reduce their experience of negative internal consequences by justifying or validating the act in their own minds (Bandura, 1999). In addition, athletes commonly validate aggressive play as tactical use of sport-sanctioned play (Bredemeier, 1985; Kerr, 2008). Such sanctioned aggressive play allows the individual to feel little or no empathy for those harmed, so long as it is in the best interest for the acting athlete (Conroy et al., 2001). This phenomenon raises the question, does the prevalence of moral disengagement in sport result in increased use of moral disengagement in daily activities outside of sports? Conroy et al. (2001) believed that when athletes are able to validate/justify the use of aggressive behaviors in sport they exhibit an overall acceptance towards engaging in aggressive acts in other aspects of life as well. The athletes theoretically understand the value of moral disengagement and continue to benefit from such beliefs in everyday life (Conroy et al., 2001). Bandura (1999) explained that moral disengagement allows the individual to gain access to valuable resources without concern over disadvantaging others, by validating self-benefiting antisocial behavior (Bandura, 1999).

**Measurements and assessments of aggression.** There have been several assessments created to measure aggression. Aggression has been examined as a multilevel behavior involving

direct or indirect acts of aggression towards self or others (Siever, 2008). Buss and Perry (1992) devised the Aggression Questionnaire (BPAQ) factors, which classify aggressive acts as instances of physical aggression, verbal aggression, projection of anger, and hostility towards others. These four factors reflect the individual's personality traits and emotional responses for aggression. Each factor encompasses the four levels of aggression: motor (physical), instrumental (verbal), arousal (anger), and cognitive (hostility; Buss & Perry, 1992). Buss and Perry (1992) created the BPAQ to fulfill the need of a dual dimensional identification of aggression as either instrumental behavior (physical aggression) or cognitive (verbal aggression) evaluation. The researchers developed the BPAQ as a way for the user to classify the varying types of aggressive acts based on social or life situations. This expansion of the BPAQ appears to better represent gender specific aggressive trends, with males committing aggressive acts that are more physical in nature (e.g., intentional physical contact directed to cause harm) and females committing more verbal/cognitive forms of aggression (e.g., spreading rumors, verbal assault, directed insults; Buss & Perry, 1992). Buss and Perry (1992) found that the BPAQ also related positively with measures of impulsiveness and competitiveness. Russell and Arms (1995) identified that individuals who scored higher in aggression reported that they enjoyed watching and engaging in physical altercations such as fighting.

In addition to typical life situations, aggression in sport is common and well documented (Kerr, 2008; Bredemeier, 1985). The initial Bredemeier Athletic Aggression Inventory (BAAGI) was a 100 item survey used to assess trait aggression in sport and included the elements of anger, hostility, and aggression (as cited in Landers, 1975). A more condensed version, the Bredemeier Athletic Aggression Inventory-Short Form (BAAGI-S), was developed by reducing the number of items based on loading factors (Bredemeier, 1975). Researchers use the Bredemeier Athletic

Aggression Inventory-Short Form (BAAGI-S) as a sport specific assessment to gauge aggressive behavior that is deemed as either justified or unjustified by the athlete (Bredemeier, 1975). Aggressive severity is gauged through a self-report evaluation using a 4-point Likert scale scoring 1 (*Strongly Agree*; justifying the act) to 4 (*Strongly Disagree*; condemning or disapproving of the act). The researchers used the BAAGI-S to categorize the mode of aggressive behavior as either hostile/reactive (cognitive evaluation) or instrumental aggression (Bredemeier, 1975). The researchers used the two-factor classification to identify the athletes' acts of aggression as impulsive/responsive behaviors that are either physical or projected/vocal forms of aggression (Bredemeier, 1975). When comparing the BPAQ scale, the measurement is used by the researchers to identify the distinction between affective and behavioral traits of aggression (Buss & Perry, 1992), while the BAAGI-S identifies aggressive transgressions in the context of sport (Bredemeier, 1975). The context-specific use for categorizing aggression through the BPAQ and the BAAGI-S will allow future researchers to identify the mode and frequency of aggressive behavior in sport and daily life, respectively.

**Classification and identification of impulsiveness.** Another emotionally responsive action performed by the individual in response to stimulus, such as aggression, is impulsiveness (Moeller et al., 2001). Impulsivity has been defined as unplanned and rapid reactions to stimuli often resulting in negative impact to the individual and/or others (Moeller et al., 2001). In general, impulsiveness has been identified as common symptom criteria for many psychiatric disorders (e.g., substance abuse and conduct disorder; Tateno et al., 2003), mTBIs (Banks et al., 2014), and neurological disorders (e.g., dementia pugilistica or "punk drunk syndrome"; Moeller et al., 2001). As previously addressed for aggression, the following areas of the brain were also found to impact impulsive behaviors: impairment of the frontal lobe causes difficulties with

cognitive reasoning, while impairment of the amygdala causes poor impulse response control (Siever, 2008). Researchers commonly identify the construct of impulsivity as a trait factor (Whiteside & Lynam, 2001). Eysenck and Eysenck (1977), both personality theorists, believed that impulsivity is a constant trait that influences an individual's behavior. In addition, Whiteside and Lynam (2001), both in agreeance with the personality classification, identified impulsivity as a personality trait that factors into cognition (premeditation and perseverance), emotion (sensation seeking), and psychopathology (urgency). When trying to develop a behavioral perspective of impulsivity, Barrett (1993) classified impulsivity as an observable behavior that individuals engage in, rather than a constant personality trait. Overall, regardless of the approach taken, a majority of observations from past research reflect that impulsivity is an individual's tendency to engage in behaviors without assessing the future inherent risks (Moeller et al., 2001; Whiteside & Lynam, 2001).

Perhaps the most comprehensive assessment of impulsivity comes from Whiteside and Lynam (2001). The goal of their research was to interpret the concept of impulsivity as a multidimensional construct, which can be expressed as more than just poor forethought. Based on the construct of personality, Whiteside and Lynam developed the UPPS (2001) that categorizes four factors of impulsivity: urgency, lack of premeditation, lack of perseverance, and sensation seeking. Urgency is identified as a tendency to react strongly to negative affect, which produces a problematic outcome following engagement in responsive behavior. A lack of premeditation occurs in the absence of reflective thinking before an individual engages in an act. A lack of perseverance describes the tendency to quit activities that are boring or difficult. Finally, sensation seeking is explained as the pursuit of exciting and new experiences (Whiteside & Lynam, 2001). These previously mentioned factors, contribute to poor judgement, which tends

to correlate with a lack of appropriate decision-making and unnecessary impulsive risk-taking (Dyer et al. 2006). These decisions made by the impulsive individual reflect the desire for instant satisfaction and self-gratification commonly associated with impulsivity (Whiteside & Lynam, 2001).

### **Emotional Regulation and mTBI**

**Aggression and impulsivity in mTBI participants.** With identifiable deficits in equilibrium, vision, and physical alertness receiving most of the attention following a concussion, physiological symptoms are generally the first or only symptoms to be addressed following a medical intervention (Cantu, 1996). The issues involving psychological health are generally overlooked and under-documented (Ling et al., 2015). Obvious impairments in cognitive function and active memory are generally present and need to be addressed to improve the overall mental well-being of the individual suffering from a TBI (Ling et al., 2015). Accordingly, it has been suggested that research should focus on whether an individual displays an increased likelihood of emotional (aggression and impulsiveness) or mood (depression) dysfunction following a concussion (Rao et al., 2009). One challenge for researchers is to universally determine whether the individual who has a concussion displays aggressive tendencies as a result of the concussion, or whether the individual was previously aggressive by nature and expresses preexisting traits that are extrapolated following the concussion (Rao et al., 2009). Another challenge researchers would want to address is whether presenting symptoms of aggression and impulsiveness affects the perspective taking abilities of the TBI patient, which are needed to reflect proper empathy towards others' interests before committing such antisocial acts. To expand on previous research regarding aggression and impulsiveness, the current study



evaluated both impulsiveness and aggression as separate influential factors of overall aggressive behavior.

One constant trend appearing throughout the literature is the unstable independent variable of mTBI/concussions. The sample pool consisting of concussed individuals necessary to perform such research is not an easily accessible population, due to the individual variability of symptoms and the duration of symptoms (Mainwaring et al., 2010). As a result, it would be difficult to collect a large enough sample and have them available for testing during a particular time period. Many of the studies involved group comparison between TBI participants, injured patients, and a control healthy population sample, in order to identify an association between aggressive and impulsive behavior in recovering mTBI participants compared to the general population (Dyer et al. 2006; Tateno et al., 2003; Till et al., 2008). In order to improve research efforts, the researchers identified several common factors, which tend to influence emotional/moral reasoning and antisocial behavior (Dyer et al. 2006; Tateno et al., 2003; Till et al., 2008). The researchers identified common factors related to socioeconomic status (SES), cultural values, and previous health history (e.g., mental and physiological), which might limit the ability of the researchers to identify a mTBI diagnosis as the primary influence of aggressive and impulsive behavior (Dyer et al., 2006; Tateno et al., 2003; Till et al., 2008). Each factors related to socioeconomic status, cultural values, and general health were identified as at-risk demographics, which included low socioeconomic status, low IQ, age, gender, culture/ethnicity, number of head injuries, and existing psychological diagnosis (Dyer et al., 2006; Tateno et al., 2003; Till et al., 2008).

Based on the previous research efforts, there appears to be a connection between impulsivity and aggression, particularly after a mTBI (Dyer et al., 2006; Tateno et al., 2003; Till

et al., 2008). Rochat et al.'s (2010) work with measuring impulsivity in mTBI participants identified that the resulting impulsivity and risk-taking can coincide with aggressive acts and influence poor decision making ability. Rochat et al. (2010) noted that impulsive behavior might increase irritability, verbal aggression, physical aggression, and loss of temper due to impatience and poor decision-making abilities by the individual. An individual's impulsive behavior may create a dangerous situation for the individual, his or her family, and those who would provide the individual with medical care (Rochat et al., 2010). In a study performed by Tateno et al. (2003), the researchers wanted to identify whether impulsiveness and aggression were positively correlated with risk taking and antisocial behavior in mTBI participants. As Tateno et al. (2003) expected, the combination of impulsiveness and aggression can impair critical thinking skills, resulting in increased risk-taking and antisocial behavior. In addition, the resulting TBI may exacerbate the individual's cognitive ability to fully process moral thought, which may increase impulsive responses of aggression (Tateno et al., 2003). As previously speculated by Tateno and colleagues (2003), they observed increased engagement in risk taking and antisocial behavior, such as substance abuse (particularly alcohol), legal trouble, and suicidal tendencies, following the occurrence of a mTBI (Tateno et al., 2003). Although the results supported their hypothesis, Tateno et al. (2003) recommended that future researchers should identify whether the presenting impulsive behavior would persist and whether impulsiveness alone would result in the previously reported aggressive behavior (Tateno et al., 2003).

In order to identify the mode of emotional and mood expression in mTBI participants, Dyer et al. (2006) reported instances of aggressive behavior between a comparison sample of post-acute injury mTBI group ( $n = 24$ ), a control post-injury spinal cord group ( $n = 21$ ), and an uninjured healthy population ( $n = 24$ ). The measures of aggression and impulsiveness were

collected using the Buss-Perry Aggression Questionnaire (BPAQ), the Barratt Impulsiveness Scale-Version 11 (Barrett, 1994), and the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960; Dyer et al., 2006). The mTBI group reported significantly higher scores on both anger (39 %), and verbal aggression (37.5 %) compared to the spinal cord injury and uninjured groups based on self-report post-injury measures (Dyer et al., 2006). Along with physical and mental decline, individuals who have experienced a mTBI reported overall higher levels of aggression and impulsivity compared to uninjured individuals (Dyer et al., 2006). However, the assumption that the mTBI group would report more physical forms of aggression than others was not upheld (Dyer, 2006). Instead, the researchers noticed that the predominate aggressive behavior reported by the mTBI group was verbal aggression on an interpersonal level. Dyer et al. (2006) also identified that the mTBI group showed higher levels of impulsiveness in comparison to the control groups, which positively correlated with the frequency of aggressive behavior expressed by the mTBI group. However, these resulting aggressive and impulsive behaviors may only prove to be generalizable for a concussed individual who continues to report persisting acute neurological symptoms (Rao et al., 2009). Conversely, Rao and colleagues (2009) stated that the presence of aggression and impulsiveness in mTBI participants might only reflect the resulting behavior due to the amount of distress experienced from the cognitive confusion in the present moment, and may not reflect the consistent aggressive or impulsive behavior that may result from the mTBI alone.

A common trend noticed by many researchers is the outcome of response bias during data collection (e.g., socially desirable responses, underestimations, overestimations, and feelings of negativity towards response; Dyer et al., 2006). Dyer et al. (2006) found common response bias when measuring aggressive and impulsive behavior, probably due to its social undesirability. In

order to control for response bias, Dyer and colleagues (2006) included The Social Desirability Scale (Crowne & Marlowe, 1960) and a participant selected “other rater.” The designated “other rater” was an individual, chosen by the participant, who knew the participant on a personal level both before and after their injury, either spinal or mTBI, who could report typical emotion and/or mood expressed by the respondent in daily life (Dyer et al., 2006). Although beneficial, the use of the “other rater” also served as a research limitation for the researchers. The “other rater” did not always have consistent knowledge of the participant’s behavior, nor could the “other rater” evaluate the participant’s emotional and cognitive reasoning in the moment (Dyer et al., 2006). The provided responses from the “other rater” could also be influenced by emotional responses of sympathy or frustration to the participant’s current situation (Dyer et al., 2006). Dyer et al. (2006) showed the prevalence rates of aggressive and impulsive behavior in a clinical setting, which compared mTBI participants to non-TBI injured and healthy population groups. In addition, the identified limitation of social desirability as a response bias is important to note in future research.

Similar to the work done by Dyer et al. (2006), Calder, Lawrence, and Manes (2004) attempted to identify aggressive response in TBI. Calder et al. (2004) expanded upon past research by studying aggression in participants based on injury-induced structural abnormalities in the brain. Calder et al. (2004) used the identification of resulting structural abnormalities in the brain post injury, to determine if these abnormalities (lesions) within the brain had an effect on the participants’ ability to recognize and process displays of general emotions, particularly anger and aggression. Previously mentioned by Siever (2008), the frontal cortex of the brain is involved with the cognitive processing of emotions, and from there the produced response is dictated by the amygdala. The region of the brain that Calder et al. (2004) identified as the

ventral striatum (VS) is the direct line of communication for the frontal cortex and the amygdala. In theory, the location of the lesion within the VS should interfere with both the identification and the arousal caused by the expression of anger (Greve et al., 2002). In the Calder and colleagues' (2004) case study, the sample consisted of four individuals who showed the presence of lesion development, confirmed through CT and MRI scans, on the VS, and a control group containing three individuals who showed lesion development on the basal ganglia (BG).

To assess the current level of cognitive and emotional impairment present in TBI participants, visual and auditory testing was used. Calder and colleagues (2004) measured whether those with a TBI diagnosis would experience difficulty recognizing facial and auditory expressions of anger, fear, and disgust by actors and the resulting emotional responses to the testing variables made by the respondents (Calder et al., 2004). With the expected impairments in emotion recognition, TBI participants produced impulsive and often unpredictable responses toward anger-provoking expressions (Calder et al., 2004). Calder et al. (2004) believed that a combination of impaired emotional recognition, emotional dysregulation, and impulsive tendencies could be problematic for TBI participants involved in recognizing anger as it was a possibly threatening event. The primary measurement used in Calder and colleagues' (2004) study was the Benton Test of Facial Recognition (Benton et al., 1983), which the researchers used to identify facial recognition, emotional identification, and non-verbal communication. Actors employed in the study portrayed emotions of happiness, sadness, fear, disgust, and surprise (Calder et al., 2004). The results supported the researchers' hypothesis that those with lesions on their VS showed frequent impairment for the recognition of anger across the four rounds of testing. However, the facial recognition impairment that Calder and colleagues (2004) observed was more prominent than the vocal impairment, which had previously been observed

by Ekman and Friesen (1975). Overall, in Calder et al.'s (2004) study, the basal ganglia groups showed no impairment in the recognition of anger, but did show a weak correlation in the impaired ability to recognize disgust. Unexpected results occurred within the ventral striatum group as well. The identification of arousal produced from the images showed two participants experiencing heightened arousal to anger and two experiencing reduced arousal. Finally, one ventral striatum impaired patient experienced dual impairment identified as the inability to recognize fear in one of the rounds of testing. Calder et al. (2004) theorized that there was consistent impairment in the recognition of anger by facial projection, but this could not predict the given response to a fear or anger producing situation due to a small sample size. In the presented work by Calder et al. (2004), a physiological justification can be made for emotional regulation and recognition deficit in TBI participants.

With the noticeable presence of cognitive impairment, fellow researchers also examined the effects that TBIs have on cognitive and social development in early age. Beauchamp and colleagues' (2013) evaluated whether the onset of a TBI occurrence in adolescence would have an effect on the development of moral reasoning and empathy, compared to uninjured peers. As stated by Bandura (1999), during the adolescent years, children are continually developing their social independence and learning new social skills through experience. Similarly, previous researchers have identified that, with the occurrence of a TBI, the cognitive and neurological functioning for the individual become impaired (Baugh et al., 2012; Gardner & Yaffe, 2015). Beauchamp et al. (2013) included 25 adolescents, with varying severity of TBI diagnoses, and 27 healthy adolescents (11 to 19 years). In order to assess moral maturity, the adolescents were placed into scenario-based situations, which tested their likelihood of engaging and/or reasoning for engaging in a moral challenging behavior (Beauchamp et al., 2013). The variables of moral

maturity and empathy were collected using the Index of Empathy for Children and Adolescents (Bryant, 1982), the Socio-Moral Reasoning Aptitude Level (Dooley, Beauchamp, & Anderson, 2010), and the So-Mature Task (Dooley, Beauchamp, & Anderson, 2010). Their level of maturity was then ranked, with morally responsible comments resulting in higher scores, and instances of engagement in socially amoral behavior resulting in lower scores (Beauchamp et al., 2013). Beauchamp and colleagues (2013) reported that, regardless of severity of the TBI diagnosis, adolescents with a TBI consistently demonstrated impairment in moral reasoning, moral maturity, and empathy scores. Although children who suffered from a mTBI fared better than their severe TBI counterparts, the mTBI group's moral maturity was not less than the control group (Beauchamp et al., 2013). Beauchamp and colleagues (2013) explained that those with greater severity of impairment showed self-centered focus that involved self-gratification, whereas the control and mild severity groups morally reflected on others and realized how their actions could affect others through perspective taking.

Although there is support the negative relationship between TBI and moral maturity, a notable limitation to the Beauchamp et al. (2013) study was that the researchers' control group was all males (Beauchamp et al., 2013). Following this conclusion, it is unclear if the same relationship exists with females. Speculations were also made for the comparable maturity levels in the age variation of 11 to 19 years based on developmental theory (Beauchamp et al., 2013). Overall, Beauchamp et al. (2013) concluded that the occurrence of a TBI early in life could result in moral maturity deficits and other developmental setbacks; whether these setbacks are long lasting was not studied.

Additional research on the progression of TBI impairment, both cognitively and psychologically, may help assess and identify the recovery outcomes for participants. The work

performed by Till et al. (2008) sought to assess the progressive improvement of cognitive functioning during a one-year span of those with TBI severity ranging from moderate to severe. In the study, those diagnosed with a TBI were assessed at the stages of 2, 5, and 12-month intervals for basic cognitive reasoning skills and processing ability. In addition to assessing cognitive functioning, Till and colleagues (2008) measured the mood and stress level of the clients. Following the initial assessment at two months, the 33 participants were then classified into two groups based on their five-month assessment that classified the participants' decline or improvement and stability in cognitive scores. Through the course of the study, 72% of participants either maintained their initial scores or had improvement by the 12-month assessment period. It was noted that 27% of TBI participants showed a decline in cognitive scores by the end of the 12-month period (Till et al., 2008).

When trying to account for the cognitive decline in the nine participants, Till et al. (2008) noted several trends. Initially, each participant in the sample population was also involved in another study where the participants received rehabilitation for their injuries. Those who were categorized as "declining" tended to be the individuals who, through insurance complications or personal reasons, were not able to attend rehab on a consistent basis. Those who showed stable or improving cognitive functioning identified as regular participants in the rehabilitation process. Till et al. (2008) noted that the possible result of improvement in cognitive functioning could not be determined by self-healing or the presence of cognitive stimulation through consistent rehab and staff involvement. However, Till et al. (2008) identified the possible positive benefits that rehabilitation had on not only the physical recovery, but also the cognitive and emotional health for those with a TBI diagnosis.



In previous research based on longitudinal cognitive evaluation, Millis et al. (2001) expressed a possible limitation to their research involving the timing of assessment compared to the occurrence of injury. Millis et al. (2001) explained that the possible decline in cognitive and mood scores could have related to the incomplete recovery of the acute symptoms. Ling et al. (2015) reported that, in some instances, the recovery rates for those 10% who do not recover in the standard time frame of 7-10 days could report chronic symptoms lasting up to three months. fMRI scanning revealed that structural stability in the brain did not return to baseline for up to 30 to 45 days' post-injury even when the individual was asymptomatic. Based on the previous stated information, the varying cognitive states of the TBI participants could produce varying scores on assessments for both mood and cognitive functioning. As a result, the varying states could skew the results due to the inability of the researchers to control recovery states. Similarly, Rao et al. (2009) expressed that when testing a particularly vulnerable population, the individuals may vary on the spectrum of impairment or recovery providing likely inconsistent results. With such variability, it is important to set targeted variables based on whether the researcher wants to chart the present impairment of the acute effects of a mTBI, or record the residual side effects.

**Aggression and impulsivity in athletes.** The subpopulation of athletes, particularly contact and team sport athletes, shows an increased risk of sustaining a mTBI due to the inherent nature of their sport (Cantu, 1996; Guskiewicz et al., 2003). In the previously reviewed studies, the populations were that of the general public with reference to males, females, and youth populations. The following research pertains specifically to the athlete population and the already perceived presence of aggression and impulsiveness associated within certain power and dominance sports, like football, hockey, and soccer (Grange & Kerr, 2011; Papas et al., 2004; Sage & Eitzen, 2013). Researchers have examined the relationships between and/or the

likelihood that athletes would engage in impulsive and aggressive behavior based on; the sport specific requirements of their sport (Huang, Cherek, & Lane, 1999; Keeler, 2007), the occurrence of a TBI (Banks et al., 2014; Mainwaring et al., 2010), and history of injury (Banks, 2014; Mainwaring et al., 2010). In addition, the classification of each sport the athletes participate in (e.g., team, individual, collision, contact, and non-contact sports) is used to identify the sample populations throughout the upcoming research.

The previous results showed that mTBI injury could result in impulsive behavior and impaired mood recognition in athletes (Banks et al., 2014); however, it was unknown if such behavior occurred in other athletes. Huang et al. (1999) chose to examine whether the instance of emotional disturbance was present at a high rate for athletes in general, based on their sport participation. Instances of emotional disturbances were identified through state provocation, which assessed aggression, frustration, and fear/escape responses (Huang et al., 1999). Huang et al. (1999) identified three factors related to the development of emotional disturbance in athletes based on the theories of instrumental learning (Weiner, 1974), attributional process (Weiner, 1974), and frustration-aggression hypothesis (Berkowitz, 1988). Huang et al. (1999) explained that each of the emotional response factors were explanations of socially learned behavior, which influence the development of prosocial or antisocial (aggressive) behavior. Within the context of sport, any learned and reinforced aggressive behavior would be identified as factors of moral disengagement which, according to some, justifies the use of aggression for goal achievement, displacement of moral responsibility, and socially influenced behavior (Boardley & Kavussanu, 2007).

In addition to cross-sectional and longitudinal designs performed by Dyer et al. (2006) and Beauchamp et al., 2013, simulated experimental designs have been used to study aggression

in the athlete population. Huang et al. (1999) hypothesized that athletes who competed in high contact sports would report higher instances of aggression, both situational and lifetime, during game simulation due to the increased amount of directed physical contact towards opponents associated within the sport. In order to simulate experiences of moral disengagement in competition, Huang et al. (1999) created a fictitious scenario where the athletes could take actions that potentially harmed a fictitious opponents' score (aggression/frustration) and/or actions that attempted to preserve the athlete's individual score (fear/escape; Huang et al., 1999). Huang et al. (1999) then recorded acts of aggression and instances of frustration exhibited in the scenario, which assessed the athletes' potential to participate in acts of verbal and physical aggression in sport and in daily life. The researchers recruited high school athletes, either classified as high (e.g., football and basketball) or low contact (e.g., track and baseball) sport athletes, and utilized a simulation that would promote a competitive state awareness (Huang et al., 1999).

Upon the study's conclusion, Huang and colleagues (1999) found that those in the high contact group reported higher levels of aggressive responses and reported more instances of life aggression compared to the low contact group (Huang et al., 1999). However, Huang et al. (1999), reported that the small sample size of 16 male athletes, 8 high contact and 8 low contact, produced a low effect size for the results. Regardless, Huang et al. (1999) added to the current knowledge of emotional states in athletes through correlations made for the occurrence of sport related aggression and daily aggression, which had been lacking in previous research (Huang et al., 1999).

In a later study, Keeler (2007) measured reports of life assertion and both life and sport aggression in a population of active male and female collision, contact, and non-contact sport

athletes. The goal of the study was to examine whether the occurrence of sport specific aggression in both males and females would reflect aggressive behavior in daily life across different levels of contact sports (Keeler, 2007). The sample consisted of 161 athletes ( $n = 92$  females and  $n = 69$  males) who were participants in either a collision (rugby), contact (soccer), or non-contact (volleyball) sport. The measurement used to assess aggression and assertion scores were collected using the Buss-Durkee Hostility Inventory (BDHI) for life aggression, the BAAGI-S for sport aggression, and the Rathus Assertiveness Schedule (RAS) for life assertion (Keeler, 2007).

Following the conclusion of the study, Keeler (2007) found no statistical difference between the level of contact sports related to aggression and assertion, however, the collision and contact sport athletes reported higher levels of sport related aggression compared to non-contact sport athletes, respectively. Importantly, within the study, the occurrence of sport aggression for males and females were equally present, but men and women expressed life aggression through different means (men reported more physical/assaultive behavior, women reported more indirect; Keeler, 2007). Keeler (2007) also observed a relationship between gender and assertiveness, with higher assertiveness scores in men compared to women. Men also reported higher instances of aggression in the form of assault ( $r = .800$ ) and women reported higher instances of indirect hostility in life ( $r = .534$ ). In addition, there was a positive correlation between life aggression and sport related aggression for athletes, both men ( $r = .451$ ) and women ( $r = .460$ ; Keeler, 2007). Keeler's (2007) results reflects the importance of noting possible gender differences in instances of life and sport aggression, which commonly find that males are the more aggressive sex (Tucker, & Parks, 2001; White & Kowalski, 1994). Although the comparison between collision, contact, and non-contact sport classification would provide a more sport specific

scenario for aggressive behavior, however, future research would look to identify varying sports types (e.g., football, baseball, wrestling, running) and level of participation (e.g., recreational, intercollegiate club, collegiate, professional).

In comparison to Keeler's (2007) work with identifying overall aggressiveness both within and outside of sport, Grange and Kerr (2011) along with Pappas, Mckenry, and Catlett (2004) wanted to identify whether the aggressive nature and plays within the sport influenced antisocial behavior *outside* of the sport. Within the two studies, Pappas and colleagues (2004) interviewed athletes for instances of both sport and life aggressive behavior in male hockey players, while Grange and Kerr (2011) collected reports on instances of both sport and life aggression in professional male Australian Rules rugby players. Each study included in-depth interviews that provided a number of instances and examples of aggression both within sport and life, despite a small sample in each study; five former hockey players (Pappas et al., 2004) and six former rugby players (Grange & Kerr, 2011). Athletes' reports of aggression both inside and outside of sport was a regular occurrence for both study populations. The hockey players in the Pappas et al (2004) study reported instances of both hostile and instrumental aggression occurring within the game. Particular instances included fighting, checking (instrumental), verbal aggression, and unsportsmanlike conduct. However, athletes within the study did not react strongly to such instances of physical or verbal aggression, citing that aggressive behavior was expected or commonly occurred within the sport already. In addition to aggression on the rink, many athletes were able to recall instances of physical and verbal aggression taking place outside of the sport. Particular instances of aggression included fighting and verbal aggression in social setting (parties and bars/clubs). A common theme for aggressive transgressions occurred in the accompaniment of binge drinking. In addition, the objectification of women occurred, which

included both physical and verbal abuse of women. Both Grange et al. (2004) and the athletes themselves, attributed the engagement in aggressive behavior to the aggressive nature of the sport along with the pro masculine dominance culture. Grange and colleagues (2004) reported that within the hockey norm, the use of aggression is encouraged by players, coaches, and fans. Many of the athletes reported that they received special recognition from players and coaches for their aggressive play and that coaches reinforced maintaining an aggressive mentality off the rink as well. Many players stated that such continual emphasis on aggression caused many players to be on edge and to develop short tempers. In addition to the pro masculine dominance, many players reported that the overuse of alcohol and fighting was a part of the male comradery within the sport, which also emphasized the devaluing of non-players and women (Pappas et al., 2004).

Likewise, Grange and Kerr (2011) reported similar life and sport aggression responses to Pappas et al.'s athletes, but from the point of view of rugby players. Anecdotally, the players Grange and Kerr (2011) interviewed reported that instances of physical aggression and verbal aggression commonly take place in rugby and are expected, but those views could be confined to that specific sample of players or just male players. In addition, a similar sense of male comradery and pro masculine dominance is emphasized in the sport of rugby (Grange & Kerr, 2011). Grange and Kerr (2011) reported that, of the eight players, six reported personal instances of aggressive play that resulted in the suspension from play. Additionally, aggression, both physical and verbal, continued to occur in life. Again, of those six players who reported suspension from play also suffered legal ramifications for acts of aggression in the form of both verbal and physical assault, which occurred in public settings (bars and nightclubs). Many of the rugby players reported that their professional status led to their involvement in fighting and verbal altercations. Such examples included provocation from the general public and the

assumption that rugby players have short tempers. Similar to the reports made by the hockey players in Pappas et al.'s (2004) study, most instances of fighting and verbal aggression that occurred for the rugby players was in the accompaniment of alcohol (Grange & Kerr, 2011). When the former rugby players reflected on past instances of aggression in life, each player reported that most of these occurrences were situationally based and that the combination of alcohol and antagonism from the public lead to their poor decision making, inability to control emotions, and aggressive behavior (Grange & Kerr, 2011).

It appears that participation in sport, particularly contact sports, may lead to a rise in aggressive behavior both on and off the field (Grange & Kerr, 2011; Pappas et al., 2004). Assumptions can be made that, within sport, there is an inherent emphasis placed on aggression and that athletes may often be expected to engage in such behavior. However, some athletes reported that engagement in the sport positively acted as a form of catharsis for the athlete and that participation in sport would provide a legal way to physically express emotions like aggression (Grange & Kerr, 2011). Sage and Eitzen (2013) reported that the presence of the male dominance culture within sport, and the increased emphasis placed on aggressive play, also influences the perspective of fans, leading to instances of fan violence. Sage and Eitzen (2013) reported that this overemphasis of aggressiveness in sport can influence the engagement of aggressive play and also have residual effects on the athletes' lives outside of sport. In relation to the current study, a multivariate analysis was used to identify possible relationships between sport aggression and instances of life aggression and impulsiveness in concussed athletes, which is lacking in the current research field.

In addition to instances of sport and life aggression, emotional and mood instability has been examined in brain injured athletes. Similar to the research done by Dyer et al. (2006) on

mTBI, spinal injury, and general healthy group comparisons, Mainwaring et al. (2010) targeted athlete populations and examined emotional behavior occurrences following a mTBI or musculoskeletal injury compared to uninjured athletes. The initial evaluations of emotional and mood states were collected over the course of a competitive season for 51 intercollegiate athletes. The researchers performed a longitudinal study that assessed the pre-morbid Profile of Mood States (POMS; McNair et al, 1981) of the athletes, specifically the total mood disturbance and depression subscale scores found within the POMS. In addition to the pretest scores, the post-morbid evaluations were given to athletes who sustained either a concussion (n = 16) or an ACL injury (n = 7) during the season (Mainwaring et al., 2010). Mainwaring et al. (2010) recollected scores from 1, 4, 8, 15, 22, and 29 days post-injury.

Mainwaring et al. (2010) found that both the concussion and ACL groups reported increased scores in mood and emotional disturbance post-injury, which signified the presence of emotional and mood distress. Mainwaring et al. (2010) reported that emotional and mood disturbance, particularly major depression and anger, accompanied the occurrence of a physical injury in athletes, based on their pre and post-injury assessment POMS scores (Mainwaring et al., 2010). Overall, the concussion group recorded three times greater emotional and mood disturbance scores during their post-injury assessment and recovery phase, compared to their pre-injury POMS evaluations. In addition, the mTBI groups' scores were then compared to the even greater reports of emotional and mood distress reported by the ACL group who experienced persisting distress up to one-month post injury. Mainwaring et al. (2010) stated that the comparison of emotional and mood states for the concussion and ACL injury groups was the primary objective of the study, however, due to the disproportional recovery time experienced by the concussed (7 - 10 days) and ACL (30 or more days) groups would provide less than ideal



scores to compare. Future researchers should incorporate injuries with comparable severity and/or equal recovery time to a mTBI (Mainwaring et al., 2010). A noticeable strength of the study was achieved through the repeated measures design, which allowed direct comparison of the resulting acute symptoms and the progression of such mood and emotional disturbance presented by the athletes during their rehabilitation (Mainwaring et al., 2010). However, due to the variability and inability to control the experimental concussion and the control ACL comparison groups, the sample sizes were small and did not produce large effect sizes (Mainwaring et al., 2010). In addition, such meticulous recording methods can be time consuming and expensive for the researcher.

In addition to the results regarding emotional and mood disturbance reported by recovering athletes (Mainwaring et al., 2010), Banks et al. (2014) chose to assess the present emotional state of athletes actively participating in their sport. Banks et al. (2014) proceeded to examine the effects that participating in combat sports, boxing and mixed martial arts, have on impulsivity in athletes. The sample of combat sport athletes were used, because due to the nature of the sport, the athletes experience an increased number of hits to the head or have been knocked unconscious (“KO’ed”) during competition or practice (Banks et al., 2014). Banks et al. (2014) expected that both types of combat sport athletes would experience high levels of impulsiveness compared to the healthy control population. Impulsiveness was measured using the Barrett Impulsiveness Scale II (BIS II; Barrett, 1994), which measured six factors affecting impulsiveness and cognition.

Interestingly, within the sample population, the combative sport athletes actually scored lower on impulsiveness compared to a healthy control (Banks et al., 2014). When attempting to identify the reason for the lower impulsiveness scores, which did not coincide with past research,

the researchers believed that scores were affected by the fighters' inability to recognize their behavior as impulsive (Banks et al., 2014). Those athletes who have previously suffered from mTBI may also suffer impairment in emotion recognition. Calder and colleagues (2004) determined that those with lesion development on the ventral striatum (VS) and the amygdala had trouble recognizing emotions and self-reporting experiences of anger. Similarly, Banks et al. (2014) identified that post-fight exposure to KO's and directed hits to the head, in MMA and boxing athletes, resulted in the development of lesions and reduced volume of the frontal cortex and amygdala. The combative sport athletes reported high levels of impulsiveness and risk-taking behavior, which only increased in relation to the number of professional fights each athlete was involved in (Banks et al., 2014). A limitation for the study, involved the inability to accurately report the total amount of hits received to the head, during training and competitive fights, and whether such hits resulted in diagnosable mTBI, excluding KO's respectively (Banks et al., 2014). In future research, the use of a longitudinal, between-group design (boxers, MMA, and healthy control) would possibly better evaluate the persistence, increase, or decrease in impulsive behaviors following an increase in mTBI exposure (Banks et al., 2014).

Based on the results and conclusions obtained regarding athlete aggression and impulsivity, the previous research influenced the structure of the current study. Within the current study, emphasis was placed on the measurement of emotional and mood dysfunction in *current* athletes with a past history of concussion(s) (Banks et al., 2014; Mainwaring et al., 2010). In addition, importance was also placed on the form (e.g., sport aggression, life aggression, and/or impulsivity) and means (e.g., hostile aggression, anger, urgency) through which athletes experience emotional and/or mood disturbances (Banks et al., 2014; Huang et al., 1999; Keeler, 2007). Next, particular instances of aggression, both sport and life, were scored and evaluated in

order to identify the particular form through which aggression occurs in athletes with a history of concussions (Grange & Kerr, 2011; Keeler, 2007; Papas et al., 2004). Finally, Keeler (2007) placed an emphasis on the importance of gender differences and the expression of aggression in life or sport in various forms on contact sports. The current research, was the first to combine the above variables: concussions, impulsiveness, aggression (sport and life), and sexual identification to identify any differences in a diverse active athlete sample population.

### **Summary**

In a current review of literature, the presence of increased aggressive and impulsive behavior appears to occur in individuals with a past history of mTBI (Dyer et al., 2006). The acute mTBI symptoms of cognitive confusion, distress, frustration, and aggression are noticeable up to 7-10 days post-injury (Mainwaring et al., 2010). The subpopulation of athletes, particularly contact sport athletes, are at an increased risk of mTBI occurrence and re-occurrence following the first TBI sustained (Guskiewicz et al., 2003). With the occurrence of mTBI, commonly injured regions of the brain are the OFC and ACC, responsible for the cognitive decision-making, and the amygdala (Siever, 2008). Those participants suffering from mTBI have been at an increased risk to respond with aggressive acts (Greve et al., 2002). As a result of the inherent and normed aggressive behavior in contact sport athletes, Keeler (2007) and Huang et al. (1999) reported that athletes' aggressive play in sport correlated positively with aggression displayed in daily life and vice versa. In addition, Bandura's theory of moral disengagement may act as a guiding model to explain the connections between aggression and impulsivity in sport. Through using the modeling of social learned behavior, researchers concluded that reinforcing of aggression, through moral justification, distorting consequences, and attributions of blame, may permit the individual to continually engage in aggressive behavior in sport (Boardley &

Kavussanu, 2007). Through comparison, the occurrence of a mTBI appears to place the individual at an increased risk of antisocial/aggressive behavior, and the necessary time needed to process and evaluate possible threatening stimuli may be affected by increased impulsivity, resulting in atypical moral behavior.

The current study focused on measuring athletes' levels of impulsivity and aggression, and whether a history of concussions would result in differences found in impulsivity and aggression compared to athletes without a history of concussions. This study was the first to combine the use of each emotional assessment (impulsivity, life aggression, and sport aggression) within the athlete population, specifically. Further, a comparison could then be made regarding emotional responses, aggressiveness and impulsivity, and whether differences existed between those with a history of concussion and those without a history of concussion. Finally, frequencies between past head injuries and past criminal behaviors were collected.

Through a comprehensive evaluation of previous research on mTBI, it is known that direct blows to the head often experienced in contact sports result in not only physical symptoms, but emotional symptoms as well (Mainwaring et al., 2010). The lasting effects of subsequent impacts to the brain directly impair the brain's ability to appropriately control high-level thinking and bodily regulation (Giza & Hovda, 2001). It was discussed that the development of lesions on the orbitofrontal cortex (OFC) and the anterior cingulate cortex (ACC) significantly diminish one's higher level reasoning skills (Calder et al., 2004). In addition, the development of lesions on the amygdala affect the regulation of one's reactions to stimuli perceived as threatening (Dyer et al., 2006). Additionally, the decrease in cognitive functioning and fluctuations in the brain's metabolic functioning can also influence the decision making process of individuals with present concussive or post-concussive symptoms (Giza & Hovda, 2001; Ptito et al., 2007). With these

deficits, individuals suffering from mTBI may lose their ability to respond to interactions in a socially appropriate manner (Dyer et al., 2006). With concussions highly present in sports, it is reasonable to believe that athletes with a past history of concussion(s) could have experienced prolonged cognitive and emotional dysfunction. Such prolonged dysfunction, could result in increased responses of aggression and impulsivity, both within sport and life. With the relatively long-lasting symptoms of mTBI, those athletes impacted may have an increased likelihood of being involved in delinquent and socially deviant behaviors that could prove to be dangerous, not only to the injured person, but to those with whom they associate within and outside of sport (Dyer et al. 2006; Siever, 2008; Tateno et al., 2003; Till et al., 2008). The previous findings influenced the three main research questions explored in the current study: (1) Would athletes who have suffered from apparent mTBIs report different levels of aggressive (life and sport) and/or impulsive behavior compared to athletes without a history of mTBI?; (2) Would athletes who reported a history of multiple concussion diagnoses, report higher aggressive and/or impulsive scores, compared to athletes with a history of a single concussion diagnosis?; (3) Would concussed male athletes report higher aggressive and/or impulsive scores, compared to concussed female athletes?; and (4) Would concussed athletes report increased incidences of criminal behavior following their first concussion diagnosis?

## **Chapter III**

### **Methods and Procedures**

#### **Introduction**

The following research was designed to examine the difference between levels of aggression (sport and life aggression) and impulsivity in those athletes who have been concussed and those who have not. Athletes with a diagnosis of a concussion, those with a history of possible undiagnosed concussions, and those without a diagnosis of a concussion were measured on aggression and impulsivity as a means to identify the prevalence of socially negative behaviors. An analysis was conducted on athlete responses to both life and sport aggression and impulsivity. In addition, an exploratory analysis regarding violent criminal behavior following the occurrence of concussion was conducted.

#### **Description of Study Population**

Of the initial 266 individuals who initiated the survey, 139 individuals completed the survey. Five individuals were excluded from the study for failing to meet the inclusion criteria of age and/or active sport participant explained in the informed consent (see Appendix A). The final athlete sample (see Table 1 for athlete demographics), contained 50 males and 89 females, and ranged in age from 18 – 34 years (mean age = 21.66, SD = 3.02). The sample included active participants in different sports, competition levels, and ethnicities (see Table 1 for athlete demographics). In addition, athletes who have never been diagnosed with a concussion ( $n = 51$ ), have been diagnosed with a concussion ( $n = 55$ ), or have self-diagnosed a concussion were included in the study ( $n = 33$ ). Athletes were assigned to a concussion group for the main analysis if they had either medical diagnosis of a concussion or a self-reported history of head injury (presumably an undiagnosed concussion). The concussed group was compared to the no

concussion diagnosis group. Of those athletes with a diagnosed concussion ( $n = 55$ ), 35 athletes were diagnosed with one concussion, and 20 athletes were diagnosed with multiple concussions (2 - 6 diagnoses). The target age of the population was selected to include those of legal age for consent (18 years of age), while excluding those of the age typical for masters' level competition (36 and older years of age). Ogles and Masters (2000) found that, as an athlete ages, the athlete's motivation towards competition and personal improvement had little influence on their athletic involvement; therefore, masters' level competitors tend to exclude themselves from regular athletic competition at a high level. In addition, the initial contacts, intercollegiate varsity and club athletes, did not allow for a wide range in ages. With this stated, masters' level athletes were excluded from the present study to control for some variance in the sample.

Table 1

*Athlete Demographics*

Demographics	N	% of total athletes	Mean	SD
Sex:				
Male	50	36%		
Female	89	64%		
Age:				
18-34	139	100%	21.66	3.02
Sport:				
Soccer	23	16.5%		
Martial Arts/MMA/Judo/Taek.	18	12.9%		
Rugby	12	8.6%		
Ultimate	10	7.2%		

Table 1 Continued

## Sport:

Lacrosse	12	8.6%
Hockey	9	6.5%
Cycling	9	6.5%
Roller Derby	7	5.0%
Water Polo	7	5.0%
Volleyball	6	4.3%
Equestrian	5	2.9%
Track & Field/Triathlon	5	2.9%
Other	32	25.2%

## Competition Level:

Club	114	82%
Recreational	27	19.4%
Varsity	15	10.8%
Amateur/Semi-pro/Pro	14	10.1%

## Ethnicity:

White (Inc. Middle Eastern)	109	77.7%
Biracial/multiracial	14	10.1%
Asian (Inc. Indian subcontinent)	9	6.5%
Hispanic or Latino/a (Inc. Spain)	6	4.3%
Black or African American (Inc. Africa & Caribbean)	1	.7%



Table 1 Continued

Concussion History:		
Concussion dx	55	39.6%
Concussion self-diagnosis	33	23.7%
None	51	36.7%
Number of Medically Diagnosed Concussions		
One Dx Cx	35	25.2%
Multiple Dx Cx (2-6)	20	14.4%

*Note.* A portion of athletes competed in multiple sports at various levels of competition, therefore totals add up to > 100%; Taek. = abbreviation of Taekwondo; Dx Cx = medically diagnosed concussion.

### **Design of the Study**

The design of the study was a 3x3 cross-sectional design. The independent variables were organized into three groups with two levels each: concussion history (yes/no), sex (male/female) of athlete with a previous history of concussion(s), and number of medically diagnosed concussions (single/multiple). The athletes were recruited using a convenience sample consisting of intercollegiate varsity, intercollegiate club, and competitive recreational athletes. Athletes were recruited to complete the anonymous self-report questionnaires on sport aggression, life aggression, and impulsiveness, which acted as three dependent variables (total sport aggression, total life aggression, and total impulsiveness). In addition, an exploratory analysis assessed the occurrence of criminal history in relation to a concussion diagnosis.

### **Data Collection Procedures**

**Instruments.** Self-report responses obtained from the Bredemeier Athletic Aggression Inventory-Short Form for sport aggression (BAAGI-S; Bredemeier, 1975; see Appendix C), the Buss-Perry Aggression Questionnaire for life aggression (BPAQ; Buss & Perry, 1992; see

Appendix D), and Urgency, Premeditation, Perseverance, and Sensation Impulsive Behavior Scale for impulsivity (UPPS; Whiteside & Lynam, 2001; see Appendix E) were utilized as measurements.

Athletes completed the BAAGI-S through the online survey, which was developed to identify overall sport aggression and is comprised of two subscales: hostile and instrumental aggression (Bredemeier, 1975). The original BAAGI, developed by Bredemeier (as cited in Landers, 1975) was a self-report scale used to identify sport-specific traits of aggressive behavior. The original long form of the BAAGI questionnaire consisted of a 100-item scale. Bredemeier (1975) identified hostile aggression as reactive/impulsive acts that were used in retaliation towards an opponent for past interactions where the outcome was to initially cause harm and/or injure another. Instrumental aggression was identified as behavior that resulted in physically harming an opponent through physical play, or the end result of a play that was intended to prevent a negative result or achieve a reward for the outcome of the game/competition (Bredemeier, 1975).

According to Bredemeier (1975), the two identifying factors of aggression were instrumental aggression and hostile/reactive aggression within the context of sport. Example items from the BAAGI-S (Bredemeier, 1975) include, “At times I cannot control my urge to harm an opponent,” and “You have to punish people if you want to win”. Instrumental aggression is measured by items such as, “I generally perform better when I keep my emotions under control and concentrate solely on my performance,” and “When things go wrong in a game, I do not tend to take it out on my opponent.” Keeler (2007) measured sport aggression using the BAAGI-S, and how it correlated to life aggression using the Buss-Durkee Hostility Inventory (BDHI, Buss & Durkee, 1957). Keeler (2007) also compared these instances of life

and sport aggression by using a variety of collegiate sport athletes involved in both collision, contact, and non-contact sports, which increased the applicability of the BAAGI-S based on sport type. Noted comparisons made by Keeler (2007) were that all sport aggression variables were significantly related to total life aggression scores for both genders. The results supported a significantly positive relationship between both male and female athletes' sport aggression scores and their overall total life aggression scores.

The BAAGI-S is a 30-item inventory, which includes 15 hostile/reactive and 15 instrumental aggression items (Bredemeier, 1975; Wall & Gruber, 1986). Responses are scored using a 4-point Likert-type scale: 1 (*Strong Agreement*) and 4 (*Strong Disagreement*; Bredemeier, 1975). Aggression scores for each subscale range from a low of 15 (*strong agreement for the justification of the behavior*) to a high of 60 (*strong disagreement for the justification of the behavior*; Wall & Gruber, 1986). Total scores of sport aggression for the BAAGI-S could range from 30 – 120, with low scores representing high levels of sport aggression (Bredemeier, 1975). The midpoint response for the overall total score is 35 (Wall & Gruber, 1986). High scores for each subscale reflect low levels of hostile/reactive and instrumental aggression (Bredemeier, 1975). The overall total score collected from the BAAGI-S was used in the present study to identify levels of athlete aggression within the context of sport. Initial testing of the BAAGI-S resulted in high alpha reliability coefficients of (.90) and (.86) for the instrumental and the hostile subscales, respectively (Bredemeier, 1975). Upon further validation, the following values were found: a coefficient of internal consistency equaling 0.68 for the instrumental aggression subscale items and 0.82 for the hostile/reactive aggression subscale items (Chantal, Robin, Vernat, & Bernache-Assollant, 2005). Previous test-retest

reliability for hostile subscales remained stable, while the instrumental subscale reduced in stability over repeated administration (Wall & Gruber, 1986).

Athletes completed the Buss and Perry Aggression Questionnaire (BPAQ) through the online Qualtrics survey, which was used in the present study to measure life aggression (Buss & Perry, 1992). The BPAQ's 29-item scale consists of four subscales: nine items for the physical aggression factor, five items for the verbal aggression factor, seven items for the anger factor, and eight items for the hostility factor. Total scores of life aggression measured by the BPAQ could range from 29 – 145, with high scores representing high levels of life aggression (Buss & Perry, 1992). The alpha coefficient values of the BPAQ were 0.85, 0.72, 0.77, and 0.83 for physical aggression, verbal aggression, hostility, and anger respectively (Buss & Perry, 1992). Test-retest reliability was categorized as moderate with an  $r = 0.47$  to  $0.88$  (Harris, 1997). Each response is recorded with a 5-point Likert scale ranging from 1 (*extremely uncharacteristic of me*) to 5 (*extremely characteristic of me*; Buss & Perry, 1992). Upon conclusion of the testing, the overall summed score collected from the BPAQ was used to identify levels of athlete aggression within the context of life events.

Buss and Perry (1992) developed each of the four subscales, which they used to categorize life aggression: physical aggression, verbal aggression, hostility, and anger. The following statements, taken directly from the BPAQ, were used to identify particular situations or behaviors that would warrant the aggressive response. An example of an act of physical aggression item is, "Given enough provocation, I may hit another person." An example of a verbal aggression item is, "I can't help getting into arguments when people disagree with me." An example of a hostility item is, "I am suspicious of overly friendly strangers." An example of an anger item is, "I have trouble controlling my temper." Dyer et al. (2006) identified aggressive

behaviors using the BPAQ and impulsiveness by using a three group comparison consisting of TBI participants, spinal cord injury participants, and generally healthy volunteers. The results from the BPAQ indicated higher responses of both verbal aggression and anger for the TBI group versus the non-concussed and healthy groups (Dyer et al., 2006). As for the other two factor items, physical aggression and hostility, there were higher frequencies for both physical aggression and hostility from pre to post-injury assessments, but they were not large enough to be deemed statistically significant by the researchers (Dyer et al., 2006).

The Urgency, Premeditation, Perseverance, and Sensation (UPPS) Impulsive Behavior Scale was also included in the online survey for the athletes to complete. The UPPS was developed by Whiteside and Lynam (2001) to measure four factors of life impulsivity: urgency, lack of premeditation, lack of perseverance, and sensation seeking. The UPPS contains four factors of impulsivity: 12 items measuring urgency, 11 items measuring lack of premeditation, 10 items measuring lack of perseverance, and 12 items measuring sensation seeking. The questionnaire was scored on a 4-point Likert scale from 1 (*Agree Strongly*) to 4 (*Disagree Strongly*; Whiteside & Lynam, 2001). Total scores of impulsiveness measured by the UPPS could range from 45 – 180, with high scores representing high levels of impulsiveness (Whiteside & Lynam, 2001). Upon further retesting by Rochat et al. (2010), alpha values for the UPPS were .83 for urgency, .91 for lack of premeditation, .92 for lack of perseverance, and .73 for sensation seeking. In a study done by Rochat et al. (2010), researchers used the UPPS to identify the changes in psychological processing following the occurrence of a TBI. The researchers identified an increase in urgency, a lack of premeditation, a lack perseverance, and a decrease in sensation seeking following the occurrence of a TBI (Rochat et al., 2010). The participants used by Rochat et al. (2010) were identified as suffering from a moderate to severe

TBI that occurred over a duration of 5 months to over 23 years with noticeable changes in cognitive processing. The overall total score collected from the UPPS was used to identify levels of athlete impulsivity within the context of life events in the present study. In addition, only the total scores were used in order to reduce the chance of a Type 1 error.

According to Whiteside and Lynam (2001), the factors that contributed to impulsiveness in individuals were a sense of urgency, a lack of premeditation, a lack of perseverance, and increased sensation seeking. An example of urgency, classified by Whiteside and Lynam (2001) and collected directly from the UPPS, identified an individual as “having trouble controlling my impulses.” One premeditation item is having a “reserved and cautious attitude towards life.” Next, perseverance was measured by another item as the ability to “finish what I start.” Finally, and example of sensation seeking is someone who “generally seek new and exciting experiences and sensations.”

Following the completion of the questionnaires, an additional self-report question of past criminal history was included. Past criminal history served as a descriptive variable for the behavioral measurement of aggressiveness and impulsiveness in athletes. The self-report of criminal history (see Appendix G) included two questions regarding timing of arrests, charges, and/or convictions of violent crimes, which have been identified as either aggressive in nature (physical or verbal) or non-aggressive crimes based on the Uniform Crime Reports (UCR). Questions included were: 1) Prior to your first concussion, have you ever been arrested, charged, and/or convicted for a crime classified as violent? Examples include: assault, aggravated assault, armed robbery, hate crimes, rape, and sexual assault; 2) Since your first concussion, have you ever been arrested, charged, and or convicted for a crime classified as violent? Examples include: assault, aggravated assault, armed robbery, hate crimes, rape, and sexual assault.; and 3) Do you

think that any of you aggressive, impulsive, and/or violent behavior has been affected, caused, and/or influenced by your concussion(s)? The final question was used as an open-ended response, where the athlete was able to comment on the prior questions, regarding any possible emotional and/or behavioral dysfunction that may have related to their experience of a concussion(s). If the athlete answered no, they were directed to the next question and if the athlete answered yes, maybe, or I do not know, they were given the option to respond via a comment text box.

Previous research regarding athlete aggression and impulsivity included, the work done by Keeler (2007), which assessed both life and sport aggression in male and female athletes. Keeler's (2007) results showed that collision and contact sport athletes reported higher levels of sport related aggression compared to non-contact sport athletes, respectively. Men also reported higher instances of life aggression in the form of assault and women recorded higher instances of indirect hostility in life. In addition, there was a positive correlation between life aggression and sport related aggression for men and women. In addition, previous research regarding the presence of aggression and impulsivity in concussed athletes included Mainwaring et al. (2010) work with rehabilitating mTBI athletes. Mainwaring et al. (2010), reported that emotional and mood disturbance, particularly major depression and anger, accompanied the occurrence of a physical injury in athletes, based on their pre and post-injury assessment. In regards to impulsivity, Banks et al. (2014) recorded that combative sport athletes reported high levels of impulsiveness and risk-taking, which only increased in relation to the number of professional fights each athlete was involved in (Banks et al., 2014).

Personal demographics (see Appendix F) collected in the present study included age, sex and gender identification, medical concussion diagnosis (concussion grade I and/or II, the

number of diagnosed or undiagnosed concussions, ethnicity, and current sport involvement (competition level and sport type). Due to the differences previously found among both gender and sex in aggression and violence research, both sex and gender identity was collected in this study (Archer, 2004; Archer & Côté, 2005). A comparison was going to be made between responses for sex and gender and for the analysis, and then gender was going to be grouped by those who reported being cisgender in two categories (male, female) and transgender (both male and female). Of the total sample of athletes, only one athlete reported as transgender (.7%). Consequently, sex was used as one independent variable in the analysis.

**Measurement techniques and procedures.** Data collection occurred after Human Subjects Review Board approval was received (see Appendix H). Data were collected through anonymous self-report questionnaires that were available online via Qualtrics software (Qualtrics, Provo, UT). Of the 762 individuals emailed, college coaches (n = 33), athletic administrators (n = 85), intercollegiate club sport directors (n = 61), club sport team captains (n = 579), and team athletes (n = 4) were informed of the nature of the study through email (see Appendix I) and given an electronic link to the anonymous survey that could be forwarded directly to the coaches or athletes. A week prior to the conclusion of the study, all contacts who responded to the initial invitation were informed on the ending date of the survey and were reminded to inform the athletes of the request. The initial contacts were selected through a cluster sampling method by randomly drawing two schools from the 11 Division I-A conferences, that had an American football team, across the United States. The athletic director, club sport director, club sport team captain at each selected university was contacted (n = 367). This sampling method was again used for each of the other conferences within the NCAA; Division I-AA (n = 94), Division II (n = 194), and Division III (n = 69). To insure for the



adequate numbers needed for the study, other personal contacts ( $n = 38$ ) included those obtained through local conventions, semi-professional athletes, Division I coaching and administrative staff located in the Midwest, Division I and Division III coaching/sport administration staff on the East coast, and club sport directors at each of the previously listed locations. Snowball sampling measures were also utilized. Upon receiving the email link to the survey, coaches and administrators were then asked to forward the email to any other university affiliated teams' coaches or administrative directors, and their own personal athlete contacts outside of the university. The snowball sampling involved asking the initial contacts to send the participation request to similar affiliates in a continuing manner in order to obtain a larger number of participants. In addition to the original email chain, the self-report survey was sent through Facebook groups, which included local and regional club teams (rugby, soccer, tennis, running, etc.), to reach additional athletes who were not involved in large university or club teams. The electronic link to a Qualtrics survey contained an informed consent (see Appendix A) and the inclusion criteria questions (see Appendix B), the BAAGI-S (see Appendix C), the BPAQ (see Appendix D) and the UPPS (see Appendix E), personal demographics (see Appendix F), and the self-report criminal history (see Appendix G).

### **Data Analysis**

Internal coefficients were calculated for each subscale prior to analysis. The survey scores from the three concussion groups were analyzed using a multivariate analysis of variance (MANOVA). The MANOVA was completed in order to examine the differences between the independent variable of concussion with two levels (history of concussion and no history of concussion) and overall scores on each of the dependent variables: sport aggression (BAAGI-S), life aggression (BPAQ), and impulsivity (UPPS). A second MANOVA analysis was used to

examine the sex differences in athletes with a previous history of concussions for the dependent variables: sport aggression (BAAGI-S), life aggression (BPAQ), and impulsivity (UPPS). The third MANOVA analysis, an exploratory analysis, was performed to examine the differences between the two levels of independent variables (single medically diagnosed concussion history and multiple medically diagnosed concussion history) and total scores on each of the dependent variables: sport aggression (BAAGI-S), life aggression (BPAQ), and impulsivity (UPPS). For the MANOVA analysis, a significance level of  $p < .05$  was used and the effect size was computed using partial eta squared. Statistical analysis was completed using IBM SPSS (Statistical Package for the Social Sciences) Statistics 23. Finally, a descriptive report was performed, which included number of pre and post-concussion violent criminal history for the athletes based on arrests, charges, and convictions of violent crimes. Additionally, the open ended responses obtained, that related to the initial three hypotheses, were used as anecdotal evidence.

## Chapter IV

### Results and Discussion

There were four objectives for the current study. The first objective was to explore the differences between athletes with a past history of concussions or no past concussion history with impulsiveness and aggression, sport and life. The second objective was to examine whether there are any differences in impulsiveness and aggression (sport and life) for athletes with a history of multiple diagnosed concussions compared to a single concussion diagnosis. The third objective was to investigate whether there was a sex difference in concussed female athletes compared to concussed male athletes for impulsiveness and aggression (sport and life). The fourth objective was to report the history of aggressive criminal behavior in the concussed athlete group, both prior to and after their first concussion. Sport aggression was assessed using the Bredemeier Athletic Aggression Inventory-Short Form (BAAGI-S; Bredemeier, 1975; see Appendix C), life aggression was assessed using the Buss-Perry Aggression Questionnaire (BPAQ; Buss & Perry, 1992; see Appendix D), and impulsiveness was assessed using the Urgency, Premeditation, Perseverance, and Sensation Impulsive Behavior Scale (UPPS; Whiteside & Lynam, 2001; see Appendix E). In addition, concussion history was collected through self-report via the athlete demographic survey, which included questions about diagnosed concussions and a self-diagnosis checklist. Athletes who indicated having a history of concussion(s) also reported their history of any aggressive crimes that they engaged in through the self-report criminal history questionnaire (see Appendix G). Statistical analyses were completed using IBM SPSS Statistics 23.

### Results

**Internal Consistency.** Preliminary analyses were used to calculate the internal consistency for the following measures. When assessing internal consistency, a Cronbach's alpha of  $\alpha \geq 0.7$  and

$\alpha \geq 0.9$  determined an acceptable and high reliability for the measurement scale (Tavakol & Dennick, 2011). The Cronbach's alpha for the BAAGI-S was low ( $\alpha = .543$ ), which was based on the total score of the assessment. In past research, Chantal et al. (2005) reported an internal consistency for the each of the BAAGI-S subscales,  $\alpha = 0.68$  for the instrumental aggression subscale items and  $\alpha = 0.82$  for the hostile/reactive subscale items. The total accumulated score for the BAAGI-S was used in the current study to reduce the occurrence of a Type I error, which may account for the low Cronbach's alpha. Next, the Cronbach's alpha for the total BPAQ was high ( $\alpha = .92$ ). Finally, the Cronbach's alpha for the total UPPS was acceptable with  $\alpha = .72$ .

**Concussion history and scores on both aggression (sport and life) and impulsivity.**

See Table 2 for means and standard deviations of the total sample's sport and life aggression and impulsivity. A one-way, between groups, multivariate analysis of variance was performed to examine differences between the independent variable (concussion history/no concussion history) and the three dependent variables: sport aggression, life aggression, and impulsiveness. There was no statistically significant difference between concussion history and the dependent variables,  $F(3, 134) = 1.53, p = .209$ ; Wilks' Lambda = .97; partial eta squared = .033.

Table 2

*Mean Sport Aggression Scores (BAAGI-S), Mean Life Aggression Scores (BPAQ), and Mean Impulsiveness Scores (UPPS) by History of Concussion for Athletes (N = 139).*

	Concussion History	Mean	SD	N
Total Sport	Concussion	76.41	6.80	88
Aggression	No Concussion	77.59	5.56	51
	Total	76.85	6.38	139
Total Life	Concussion	71.82	16.13	88
Aggression	No Concussion	65.88	17.80	51
	Total	69.62	16.95	139
Total UPPS	Concussion	93.32	9.36	88
	No Concussion	95.73	10.47	51
	Total	94.21	9.81	139

*Note.* Low mean scores for sport aggression = high sport aggression; High mean scores for life aggression = high life aggression; High mean scores for impulsiveness = high impulsiveness.

**Multiple concussions and aggression (sport and life) and impulsivity.** See Table 3 for means and standard deviations of the total sample's sport and life aggression and impulsivity. A one-way, between groups, multivariate analysis of variance was performed to investigate the comparison between the independent variable levels (single medically diagnosed concussion and multiple medically diagnosed concussions) and the differences in the three dependent variables: sport aggression, life aggression, and impulsiveness. There was no statistical difference between concussion amount and the dependent variables,  $F(3, 50) = .33, p = .81$ ; Wilks' Lambda = .98; partial eta squared = .019.

Table 3

*Mean Sport Aggression Scores (BAAGI-S), Mean Life Aggression Scores (BPAQ), and Mean Impulsiveness Scores (UPPS) by Number of Concussion Diagnoses.*

	Single vs Multiple Dx Cx	Mean	SD	N
Total Sport	Single	78.15	7.21	34
Aggression	Multiple	76.75	6.71	20
	Total	77.63	7.00	54
Total Life	Single	72.15	16.77	34
Aggression	Multiple	70.70	13.50	20
	Total	71.61	15.49	54
Total UPPS	Single	93.76	9.58	34
	Multiple	95.00	8.73	20
	Total	94.22	9.21	54

*Note.* Dx Cx = Diagnosed Concussion.

### **Sex differences in concussed athletes' aggression (sport and life) and impulsivity.**

See Table 4 for means and standard deviations of the total sample's sport and life aggression and impulsivity. A one-way, between groups, multivariate analysis of variance was performed to investigate the comparison between the independent variable (concussed male, concussed female) and the differences in the three dependent variables: sport aggression, life aggression, and impulsiveness. There was no statistically significant difference between sexes in concussed athletes across the dependent variables,  $F(3, 83) = .07, p = .97$ ; Wilks' Lambda = .997; partial eta squared = .063.

Table 4

*Mean Sport Aggression Scores (BAAGI-S), Mean Life Aggression Scores (BPAQ), and Mean Impulsiveness Scores (UPPS) for Male and Female Concussed Athletes.*

	Birth Sex	Mean	SD	N
Total Sport	Male	76.00	7.51	31
Aggression	Female	76.64	6.44	57
	Total	76.41	6.80	88
Total Life	Male	71.81	14.06	31
Aggression	Female	71.82	17.30	57
	Total	71.82	16.13	88
Total UPPS	Male	93.10	9.27	31
	Female	93.45	9.48	57
	Total	93.32	9.36	88

**Self-report criminal history for concussed athletes.** A descriptive report was tabulated the pre and post-concussion violent criminal history for the athletes who reported a history of concussions. No athletes reported any arrests, charges, and/or convictions of violent crimes prior to their first concussion. Two athletes (2.7%) reported engagement in aggressive criminal behavior *after* their first concussion (see Table 5). See Table 5 for frequencies of athletes who believed there was a connection between their concussion history and possible changes in their emotions, mood, and/or aggressive behavior. Finally, the athletes were given an open-ended text box to comment if they perceived a possible connection between their concussion history and aggressive behavior. Of the 88 athletes (63.3%) with a history of concussions, four individual

athletes' (4.5%) statements included a comment on anger, "From playing Rugby, I realized that I have gotten more angry when going out." Another athlete responded, "I got 2 concussions over four months ago and have felt more angry/irritable, more volatile, and less focused since then." A third athlete responded, "I just don't feel the same since the concussion, like theres [sic] something wrong with me now." Finally, one athlete responded, "i [sic] do not think i [sic] became more aggressive following my concussion, but i [sic] think my emotions became more muted."

Table 5

*Self-report Criminal History by Athletes with a Past History of Concussions*

	<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Prior to 1 <sup>st</sup> Cx Arrest History	yes	0	0
	no	88	100
	Total	88	100
Since 1 <sup>st</sup> Cx Arrest History	yes	2	2.7
	no	86	97.3
	Total	88	100
Perceptions of Connection Between Cx and Behavior	yes	0	0
	no	75	85.2
	I do not know	5	5.7
	maybe	8	9.1
	Total	88	100

*Note.* Cx = Concussion.



## Discussion

By the current study, it was determined that there were no statistically significant mean differences in dependent variables (sport aggression, life aggression, and impulsiveness) for each independent variable level: concussion history, number of diagnosed concussions, and sex differences in concussed athletes. These current findings contradict previous findings that athletes with a previous history of concussions displayed emotional, mood, and/or behavioral instability during their recovery (Mainwaring et al., 2010) and continuation with the sport (Banks et al., 2014). Although in most instances, researchers concluded that there was a peak in emotional and mood disturbances often occurring during the recovery period of acute concussive symptoms (Mainwaring et al., 2010), or years after the concussion occurred and the athlete had ceased playing their sport (McKee et al., 2009). Perhaps there were no differences found in the current study because the athletes who participated in the current study were cleared of their acute concussive symptoms and continued participating in their sport. The aim of the current study was to examine the emotional and mood responses in concussed athletes *after* they have recovered from the acute symptoms and have returned to play in their particular sport. Banks et al. (2014) contributed to this same aim by measuring the impulsiveness in active combat sport athlete, MMA fighters and boxers. Although Banks et al. (2014) only studied one variable, impulsivity, the researchers found a relationship between the more exposure to professional fights and full contact training (knockouts and direct hits to the head) with increased instances of impulsive behavior and/or thoughts. In addition, a portion of the athletes in their study actually scored lower on measures of impulsiveness, possibly due to the athletes' inability to recognize that their behavior was deemed impulsive. Banks et al. (2014) attributed the athletes' inability to identify impulsive behavior as being related to a possible muting of emotions, due to the

experience of mTBIs. The athletes in the current study may have also had difficulty identifying or experiencing their emotions, moods, and/or behaviors as aggressive and/or impulsive, due to the possible post-concussive cognitive symptoms. A similar conclusion could be made in the present study regarding one comment made by an athlete, “i [sic] do not think i [sic] became more aggressive following my concussion, but I [sic] think my emotions became more muted.” It is possible that the muting of emotions post-concussion is another common consequence after concussion that should be examined as closely to the often mentioned enhancement of emotions, such as aggression (Banks et al., 2014; Mainwaring et al., 2010).

In regards to the first hypothesis, there was no statistical difference between scores of sport aggression, life aggression, and impulsiveness in athletes with a history of concussions compared to those athletes with no past concussion history. Interestingly enough, both the concussion group and the no concussion group reported moderate scores for sport aggression (concussion group  $M = 71.82$ , no concussion group  $M = 65.88$ ), with scores ranging from 30 to 120 on the BAAGI-S. The frequency of sport related aggression may have occurred due to the objective of the sports played by the athletes in this study, with a portion of the athletes participating in non-contact individual and/or team sports compared to contact individual and/or team sports athletes; however, athletes were not compared based on sport type for each of the independent variable comparisons. The context of the sport (contact, non-contact, and individual/team sports) was noted as a source of relevance for the occurrence of aggressive behavior (Boardley & Kavussanu, 2007; Huang et al., 1999) and for impulsiveness (Huang et al., 1999). In each study, the researchers reported and/or commented that the context and rules of each particular grouping of sports would provide a contextual framework for aggressive behavior and that each sport reinforced specific norms for such behavior. However, based on the research

by Keeler (2007), it was reported that athletes who participated in collision, contact, and non-contact sports had similar sport related aggression. Therefore, it is recommended that future research focus on either individual or team sport athletes to control for sport type differences.

Based on the second hypothesis, there was no difference statistically between athletes with multiple medically diagnosed concussions and athletes with a history of one medically diagnosed concussion on the dependent variables (sport aggression, life aggression, and impulsiveness). When developing the second hypothesis, it was taken into consideration that previous concussion researchers found the culminating effect that a history of multiple mTBIs could have on the athletes' cognitive functioning and emotional regulation abilities (Guskiewicz et al., 2003). In addition, researchers identified the negative effect that concussions have on the cognitive and emotional well-being of athletes with a history of multiple concussion diagnoses and the lasting effects concussions have on the athletes long after their playing career has ended (Gardner & Yaffe, 2015; Guskiewicz et al., 2005; McKee et al., 2009). Specifically, Guskiewicz et al. (2005) reported that retired athletes with multiple diagnosed concussions were three times more likely to develop Alzheimer's Disease-like symptoms and to experience mild cognitive impairment, commonly expressed as memory impairment and cognitive decline. However, based on this study alone, the current findings cannot support the notion that a single concussion diagnosis may have similar effects as multiple concussion diagnoses on athletes' aggression and impulsivity, because there was no statistical difference between those athletes with a history of concussions compared to athletes with no past concussion history. Overall, it appears that athletes have the same levels of aggression and impulsivity regardless of concussion history or sex.

Based on the third hypothesis, there was no difference statistically between female athletes with a history of concussions compared to male athletes with a history of concussions on the dependent variables (sport aggression, life aggression, and impulsiveness). Similarly, the findings from the third analysis resulted in no difference statistically between the sexes on the dependent variables. The idea for the third hypothesis was based on previous research of athlete aggression and sex differences, which deconstructed the common misconception that males are often more aggressive than females (Archer, 2004; Archer & Côté, 2005; Blinde, 1989; Keeler, 2007; Tucker & Parks, 2001). Specifically, Keeler (2007) reported that forms of aggression (sport and life) occurred at similar levels for both male and female athletes; however, the mode of expression might vary between them. However common the perception of these sex differences are, the expression of aggression is similar in both sexes (Archer & Côté, 2005; White & Kowalski, 1994). Likewise, Archer (2004) and Keeler (2007) reported that either males and male athletes, respectively, expressed aggression more through physical/assaultive behavior and females and female athletes, respectively, reported more indirect forms of aggression. The current findings included no differences between the two sexes on total life aggression, sport aggression, and life impulsivity. Based on the mean scores for aggression alone, this contradicts the previous assumption that males and male athletes are often more aggressive than females and female athletes (Archer, 2004; Archer & Côté, 2005; Tucker, & Parks, 2001; White & Kowalski, 1994). Likewise, these results may be more in line with the current belief that sex does not influence the expression of aggression. In addition, since the instatement of Title IX, women now have a larger representation in collegiate sports, specifically in team sports including contact like soccer, rugby and ice hockey. The expansion and variety of sport opportunities for women, particularly in sports that include contact, could provide the rationale for equitable scores on

sport aggression in comparison to the male sex (Blinde, 1989; Keeler, 2007; Tucker & Parks, 2001; Wall & Gruber, 1986). Again, future researchers may want to separate comparisons according to sport type.

Finally, a descriptive report was evaluated, regarding previously concussed athletes' engagement in aggressive criminal activity. The hypothesis was that athletes with a previous history of concussions would report a higher rate of aggressive criminal behavior following the athlete's first concussion; however, the result did not support the hypothesis. This hypothesis was based on individuals with a past history of concussions having reported greater emotional and cognitive instability in previous research (Mainwaring et al., 2010; Rao et al., 2009; Rochat et al., 2010; Tateno et al., 2003). Additionally, the assumption was that the increased risk to engage in impulsive and aggressive behavior, especially for certain athletic populations who are at an increased risk for concussions, would lead to the engagement in aggressive criminal behavior. Contrary to the hypothesis, the concussed athlete sample did not report a high number of incidents involving the engagement in aggressive criminal behavior, both prior and/or after the first concussion. In addition to the initial hypothesis, when asked if the athletes believed there may be a connection between their possible change in emotions, mood, or aggressive behavior following a concussion, not one athlete indicated a definitive "yes;" however, some athletes indicated the possibility. A few athletes did report in an open-ended format, that there was a connection between their concussion history and changes in their aggressive and/or impulsive behavior. For two of the athletes, the experiences of irritation, anger, and volatility were similar to the behavioral and emotional responses reported previously by concussed individuals and athletes (Mainwaring et al., 2010; Rao et al., 2009; Rochat et al., 2010; Tateno et al., 2003); however, this disturbance does not appear to manifest in aggressive criminal behavior. However,

the lack of reported criminal history could have been affected by social bias response, due to the individual not wanting to admit to committing a violent crime. In addition, two athletes experienced emotional and behavioral dysfunction that resulted in either confusion or the muting of emotions entirely, which active athletes reported in Banks et al.'s (2014) study. Although each of the two athlete responses in the current study were more speculative in nature, the athletes did appear to experience some form of emotional, mood, and/or behavioral distress, either through some form of aggression or on the opposite spectrum of muted emotions. It is possible that the post-concussive symptoms of cognitive confusion affected the emotional and/or behavioral responses of each athlete differently. It was reported by Banks et al. (2014), that active athletes with a history of mTBI either engaged in more impulsive behavior, did not realize that their behavior was deemed impulsive, or experienced a muted emotional state. More research is needed on the possible emotional muting that may occur post sport concussion.

In reference to the results, many things were learned following the conclusion of the current study. The expression of sport aggression, life aggression, and impulsiveness was present in athletes, however, history of concussions, number of concussions, and sex differences of concussed athletes did not influence the responses in a way that supported the empirically-based hypotheses. In reference to sport aggression, the total BAAGI-S did not provide adequate internal consistency when used, which could have influenced overall results. A possible explanation for the occurrence, could be that the sport specific questions posed in the BAAGI-S were not relatable to individual sport athletes (e.g., swimming, equestrian) who cannot engage in instrumental or hostile aggression given they do not have an opportunity to engage physically with opponents.

Although the current results did not support the conclusions of past research, there were limitations to the current study. An initial limitation for the current study, was only using total scores when measuring the independent variables. In doing so, only using of total scores could have limited the overall findings of the research if there were different results embedded in the subscales of the BAAGI-S or UPPS. Another limitation for the current research was the low response rate, sample numbers, and disproportional numbers of male versus females, likely affected the strength of the comparisons. Further, due to the subject matter of concussions, the university staff, coaches, and/or team captains may not have wanted their athletes to participate in the research and several responded that they did or did not believe that concussions occurred in their sport (e.g., volleyball, tennis). This resistance to participation may have influenced the actual distribution of the survey. Although difficult to control for, it is important to note that response bias, social desirability, as a possible limitation of research in regards to measures of aggression (sport and life), impulsiveness, and past aggressive criminal history. In addition, the age of the sample (young adult) and the possible rules set forth by institutions or athletic program might have influence the engagement in criminal behavior. More specifically, it could be that an intercollegiate athlete who had a criminal arrest and conviction was subsequently dropped by the team, and thereby, would not have been reached in the current sample procedure. Another limitation occurred with the inclusion of the open ended question for possible aggressive, impulsive, and/or violent behavior following the first or subsequent concussions. The prompt to the question was slightly ambiguous and may have been confusing to the athlete because of its placement within the survey. Lastly, time since last concussion was not measured, which may have affected results. Again, Mainwaring et al. (2010) reported that the peak occurrence of emotional, mood, and/or behavior dysfunction occurred during the recovery period of the

concussion. Athletes with a past history of concussions in the current study may have had their concussions years ago, thereby, they may have already recovered fully from possible post-concussion symptoms.

Even though there was no statistical difference for each group comparison: concussion history, number of diagnosed concussions, and sex differences in concussed athletes for measures of sport aggression, life aggression, and impulsivity, there were a few noteworthy findings. As stated previously, the lack of sex differences between concussed athletes in comparison to the dependent variables, specifically aggression, is important to note. In comparison to past research, no attempts were made to assess active athletes with a history of concussions to active athletes with no past history of concussions with the dependent variables (sport aggression, life aggression, and impulsiveness); which was accomplished through the current study. Additionally, the self-report comment section, regarding concussions and possible emotional, mood, and/or behavioral dysfunction would provide athletes the means to report their experiences following a concussion. Based off the athletes' self-report comments, the use of qualitative measures to examine the hardships some athletes with a history of concussions may face is worthy of future examination.



## **Chapter V**

### **Summary, Conclusions, and Recommendations**

#### **Summary**

The objective of the current study was to examine whether or not there are differences in aggression and impulsivity for those athletes with a past history of concussions in comparison to athletes with no previous history of concussions. First, it was hypothesized, that the concussed athlete group would report more life aggression, sport aggression, and impulsiveness compared to a non-concussion group; however, there were not statistical differences between the two groups for life aggression, sport aggression, and impulsiveness. Given that athletes with a past history of concussions have a three times greater risk of experiencing a subsequent concussion (Guskiewicz et al., 2003), it was important to identify whether there was a difference in aggressive and impulsive behavior in athletes suffering from a single concussion in comparison to athletes with multiple concussion(s). It was hypothesized that athletes with multiple medically diagnosed concussions would report more life aggression, sport aggression, and impulsiveness compared to single medically diagnosed concussion athletes. Again, results showed no statistical difference between the two groups for aggression (sport and life) and impulsiveness. In addition, given conflicting prior evidence on sex differences, it was important to identify whether there was a difference in aggressive and impulsive behavior for concussed female and concussed male athletes. It was hypothesized that concussed male athletes would report high overall impulsiveness, sport aggression, and life aggression scores compared to concussed female athletes. However, results showed no statistical difference between the two groups for aggression (sport and life) and impulsiveness. Finally, as a means to identify a possible behavioral measure of life aggression, a self-report criminal history background was included. The questions were

used by the researcher to identify the engagement in aggressive criminal behavior, both prior to and after the athletes reported their first concussion. Based on past research, the engagement in deviant and aggressive behavior has been positively correlated with those with a past history of concussions (Rochat et al., 2010). It was hypothesized, that athletes with a history of concussion(s) would report more instances of aggressive criminal behavior following their first concussion; however, only two of eighty-eight athletes reported engaging in aggressive criminal behavior following their first concussion.

### **Conclusion**

It appears that there are no differences between the independent variables: concussion history, number of diagnosed concussions, and sex on measures of sport aggression, life aggression, and impulsiveness. Qualitatively, some athletes reported changes in their emotions, mood, and/or behavior following their first concussion, which may justify future qualitative research. Overall, although the primary results did not support the three hypotheses, the anecdotal accounts of the few select athletes who reported emotional, mood, and/or behavioral disturbance following their history with concussions identified the importance of such research and expanded upon the current concussion related research.

### **Recommendations**

Based on past research, there is an emphasis on expanding the current knowledge of concussions beyond safety regulations and return to play protocols, but also focusing on the emotional, cognitive, physical wellbeing of the athlete (Guskiewicz et al., 2003; Ling et al., 2015; Mainwaring et al., 2010). Additionally, concussions continue to be an important topic in today's literature, due to their prevalence within sport (Thurman et al., 1998; Gardner & Yaffe, 2015) and the recent diagnoses of CTE in former professional and collegiate athletes (Gardner &

Yaffe, 2015; McKee et al., 2009). With an abundance of physiological knowledge surrounding concussions and the effects experienced by the individual, it is important to continue to explore new avenues in order to expand the current knowledge of concussions and their effects on individuals, especially within the athletic population.

Based on the results and limitations of the current research, future researchers could benefit from the following recommendations. Initially, it is important to obtain a larger sample to increase the likelihood of obtaining more athletes who have experienced a concussion. In addition, the current survey did not ask the participants how many self-concussion diagnoses each athlete had experienced; therefore, this group could not be used in the analysis regarding number of concussions. In the future, the number of self-diagnosed concussions could be collected and included in an analysis regarding number of concussions. Researchers may also benefit from targeting sports with higher known instances for concussions, in order to possibly obtain more athletes with a prior history of concussions or head injuries. In reference to a behavioral measure of aggression, researchers should identify more common instances of aggression (verbal, physical, hostile, and anger) that occur in the daily life of the athletes with a history of concussion(s) instead of past criminal history, which may minimize the response bias of the athletes. In addition, researchers should address each subscale of life and sport aggression in order to identify whether there is any sex related difference that the current research did not identify. Next, future researchers may want to focus their efforts on identifying other possible emotional, mood, and behavioral dysfunction in athletes with a history of concussion(s) in order to identify ways that dysfunction could manifest. Future researchers, may also want to focus primarily on the qualitative accounts of athletes in order to identify the actually emotional, mood, and/or behavioral dysfunction that may have occurred following their concussion(s). Finally,

future researchers may benefit from identifying aggressive and impulsive responses in athletes, based on sport type (e.g., individual versus team sports; contact level). By measuring the sport specific variable, researchers could identify whether the particular type of sport (contact versus non-contact and team versus individual) could result in differences in aggressive and/or impulsive behavior in athletes with or without a history of concussion(s). Finally, it may be limiting to hypothesize that athletes may only experience a heightened sense of emotional disturbance after a concussion; it could be that their emotions are muted. Through addressing the following limitations and suggestions, future researchers may improve the likelihood of fully understanding the possible emotional, mood, and/or behavioral effects concussions may have on active athletes.

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Appendix A  
Informed Consent

## **Consent Form**

### **Purpose and Benefit:**

Researchers in the field of sport psychology are interested in studying the emotional states in athletes and the differences in emotional behavior following a concussion or apparent head injury. By participating, you will be furthering research in the field of sport psychology. It is estimated to take 10 – 15 minutes to complete.

### **REGARDING MY PARTICIPATION IN THIS STUDY, I UNDERSTAND THAT:**

1. I am at least of the age of 18 and no older than 35 years old.
2. I consider myself an active participant in competitive sport regardless of current season; off-season, pre-season, and/or mid-season.
3. Although the study looks to compare the emotional states of athletes with concussions to non-concussed athletes, it is not required that I have been diagnosed with a concussion to participate in the survey.
4. This research study will involve the completion of four brief surveys and filling out a demographics questionnaire.
5. My participation and information will remain confidential and anonymous. My coach and/or college/university will not be informed about whether or not I participate in this study.
6. Although there are no direct personal benefits from completing this study, my participation may further the knowledge of the effects of concussion.
7. While there are no expected risks to participating, some questions may cause me some discomfort.

8. My participation is voluntary and I may choose to withdraw from participating at any time without penalty or loss of benefits.
9. This research is being conducted by Jason Haddix, a Master's student at Western Washington University, under the supervision of Dr. Linda Keeler.
10. Any questions that you have about this study or your participation may be directed to Jason at haddixj@wwu.edu, or Janai Symons at janai.symons@wwu.edu, Research Compliance Officer at (360) 650-3082.

The Human Subjects Review Committee (HSRC) at Western Washington University has approved this study. If you have any questions about your participation or your rights as a research participant, you can contact Janai Symons the WWU Human Subjects Review Committee (HSRC), at (360) 650-3082 or via email: janai.symons@wwu.edu. If during or after participation in the study you suffer from an adverse effect as a result of participation, please notify the WWU HSRC.

\*\*\*\*\*

**By clicking on this box to continue the survey, I indicate that I understand and have read the above description, I am at least 18 years of age or older, and I agree to participate in this study.**



Appendix B  
Inclusion Questions

### **Inclusion Questions**

By answering yes to these following questions, the participant was accepted for inclusion into the current study:

- 1) Are you between the ages of 18-35?
- 2) Do you consider yourself an active participant in competitive sport regardless of current season; off-season, pre-season, and/or mid-season?

## Appendix C

Bredemeier Athletic Aggression Inventory-Short Form (BAAGI-S)

**BAAGI-S****Instructions:**

This instrument includes a number of statements which people use to describe themselves in specific sport situations. Please do not omit an item even though it may be difficult to make a choice. Your decision, in each instance, should be in terms of what you believe, how you feel, or how you would react, not in terms of what you think you should believe, feel or respond. Item responses should be a description of your own personal beliefs, feelings or reactions.

Using the 4-point scale shown below, indicate how you would respond to each of the following statements. Place your rating in the circle to the right of the statement.

Key: 1 = (Strong Agreement) 2 = (Agreement)

3 = (Disagreement) 4 = (Strong Disagreement)

1. \_\_\_\_ I am usually unaware of angry feelings when I compete.
2. \_\_\_\_ During an athletic performance, I am often more irritated than people may think.
3. \_\_\_\_ I enjoy frustrating my opponent.
4. \_\_\_\_ When things go wrong in a game, I do not tend to take it out on my opponent.
5. \_\_\_\_ I relish picking my opponent apart piece by piece until that individual has nothing left.
6. \_\_\_\_ When I have an opponent down, I delight in keeping him/her down.
7. \_\_\_\_ When my opponent gets the best of me, I often get mad enough to throw something.
8. \_\_\_\_ At times I cannot control my urge to harm an opponent.
9. \_\_\_\_ At times I am surprised by my anger toward an opponent.
10. \_\_\_\_ When the unexpected happens in a contest, I always adjust without becoming irritated.
11. \_\_\_\_ I am usually calm and poised before participating in an athletic event.
12. \_\_\_\_ It is easier for me to compete against an opponent I do not know personally.

Key: 1 = (Strong Agreement) 2 = (Agreement)

3 = (Disagreement) 4 = (Strong Disagreement)

13. \_\_\_\_ Performing well is more important to me than the satisfaction I get from beating somebody.
14. \_\_\_\_ It does not take much to upset me in an athletic contest.
15. \_\_\_\_ There have been times when I have “rubbed it in” after I have done something well, or my rival has done something poorly.
16. \_\_\_\_ You have to punish people if you want to win.
17. \_\_\_\_ When my coach doesn’t treat me right, I can feel resentment build up inside myself.
18. \_\_\_\_ I generally perform better when I keep my emotions under control and concentrate solely on performance.
19. \_\_\_\_ I usually do not withdraw from my teammates after frustrating competitive experiences.
20. \_\_\_\_ Seldom is my opponent able to pressure me into making an error.
21. \_\_\_\_ There have been times, in the heat of competition, when I have become aware of another side of me that I didn’t realize existed.
22. \_\_\_\_ I have never had a temper tantrum in a competitive sport situation.
23. \_\_\_\_ During competition, I more often go into an inner shell to listen to my own voice than listen to the outside noise.
24. \_\_\_\_ A winner is someone whose performance is completely detached from emotional responses to other people.
25. \_\_\_\_ I like to compete because I can take my frustrations out on my opponent in a sport event.
26. \_\_\_\_ My anger against officials seldom goes unchecked.

Key: 1 = (Strong Agreement) 2 = (Agreement)

3 = (Disagreement) 4 = (Strong Disagreement)

27. \_\_\_\_ It is easier for me to get psyched up for a competitive situation by thinking negative thoughts about my rival.
28. \_\_\_\_ I have never intensely disliked an opponent.
29. \_\_\_\_ I have never felt any desire to harm an opponent.
30. \_\_\_\_ I am aware of my opponent only for the sake of strategy.

## Appendix D

### Buss-Perry Aggression Questionnaire (BPAQ)

## BPAQ

### Instructions:

Using the 5-point scale shown below, indicate how uncharacteristic or characteristic each of the following statements is in describing you. Place your rating in the circle to the right of the statement.

1 = (*extremely uncharacteristic of me*) 2 = (*uncharacteristic of me*) 3 = (*neutral*)

4 = (*characteristic of me*) 5 = (*extremely characteristic of me*)

1. \_\_\_\_ Once in a while I can't control the urge to strike another person.
2. \_\_\_\_ Given enough provocation, I may hit another person.
3. \_\_\_\_ If somebody hits me, I hit back.
4. \_\_\_\_ I get into fights a little more than the average person.
5. \_\_\_\_ I have to resort to violence to protect my rights.
6. \_\_\_\_ There are people who pushed me so far that we came to blows.
7. \_\_\_\_ I can think of no good reason for ever hitting a person.\*
8. \_\_\_\_ I have threatened people I know.
9. \_\_\_\_ I have become so mad that I have broken things.
10. \_\_\_\_ I tell my friends openly when I disagree with them.
11. \_\_\_\_ I often find myself disagreeing with people.
12. \_\_\_\_ When people annoy me, I may tell them what I think of them.
13. \_\_\_\_ I can't help getting into arguments when people disagree with me.
14. \_\_\_\_ My friends say that I'm somewhat argumentative.
15. \_\_\_\_ I flare up quickly but get over it quickly.
16. \_\_\_\_ When frustrated, I let my irritation show.



1 = (*extremely uncharacteristic of me*) 2 = (*uncharacteristic of me*) 3 = (*neutral*)

4 = (*characteristic of me*) 5 = (*extremely characteristic of me*)

- 17. \_\_\_\_ I sometimes feel like a powder keg ready to explode.
- 18. \_\_\_\_ I am an even-tempered person.\*
- 19. \_\_\_\_ Some of my friends think I'm a hothead.
- 20. \_\_\_\_ Sometimes I fly off the handle for no good reason.
- 21. \_\_\_\_ I have trouble controlling my temper.
- 22. \_\_\_\_ I am sometimes eaten up with jealousy.
- 23. \_\_\_\_ At times I feel I have gotten a raw deal out of life.
- 24. \_\_\_\_ Other people always seem to get the breaks.
- 25. \_\_\_\_ I wonder why sometimes I feel so bitter about things.
- 26. \_\_\_\_ I know that "friends" talk about me behind my back.
- 27. \_\_\_\_ I am suspicious of overly friendly strangers.
- 28. \_\_\_\_ I sometimes feel that people are laughing at me behind my back.
- 29. \_\_\_\_ When people are especially nice, I wonder what they want.

“\*” This items are reversed scored.

## Appendix E

Urgency, Premeditation, Perseverance, and Sensation Impulsive Behavior Scale (UPPS)

### UPPS Impulsive Behavior Scale

#### Instructions:

Below are a number of statements that describe ways in which people act and think. For each statement, please indicate how much you agree or disagree with the statement. If you “Agree Strongly” select 1, if you “Agree Somewhat” select 2, if you “Disagree Somewhat” select 3, and if you “Disagree Strongly” select 4. Be sure to indicate your agreement or disagreement for every statement below.

1 = (*Agree Strongly*) 2 = (*Agree Somewhat*) 3 = (*Disagree Somewhat*) 4 = (*Disagree Strongly*)

1. \_\_\_ I have a reserved and cautious attitude toward life.
2. \_\_\_ My thinking is usually careful and purposeful.
3. \_\_\_ I am not one of those people who blurt out things without thinking.
4. \_\_\_ I like to stop and think things over before I do them.
5. \_\_\_ I don't like to start a project until I know exactly how to proceed.
6. \_\_\_ I tend to value and follow a rational, “sensible” approach to things.
7. \_\_\_ I usually make up my mind through careful reasoning.
8. \_\_\_ I am a cautious person.
9. \_\_\_ Before I get into a new situation I like to find out what to expect from it.
10. \_\_\_ I usually think carefully before doing anything.
11. \_\_\_ Before making up my mind, I consider all the advantages and disadvantages. (R)
12. \_\_\_ I have trouble controlling my impulses.
13. \_\_\_ I have trouble resisting my cravings (for food, cigarettes, etc.).
14. \_\_\_ I often get involved in things I later wish I could get out of.

1 = (*Agree Strongly*) 2 = (*Agree Somewhat*) 3 = (*Disagree Somewhat*) 4 = (*Disagree Strongly*)

15. \_\_\_\_ When I feel bad, I will often do things I later regret in order to make myself feel better now.
16. \_\_\_\_ Sometimes when I feel bad, I can't seem to stop what I am doing even though it is making me feel worse.
17. \_\_\_\_ When I am upset I often act without thinking.
18. \_\_\_\_ When I feel rejected, I will often say things that I later regret.
19. \_\_\_\_ It is hard for me to resist acting on my feelings.
20. \_\_\_\_ I often make matters worse because I act without thinking when I am upset.
21. \_\_\_\_ In the heat of an argument, I will often say things that I later regret. (R)
22. \_\_\_\_ I am always able to keep my feelings under control.
23. \_\_\_\_ Sometimes I do things on impulse that I later regret.
24. \_\_\_\_ I generally seek new and exciting experiences and sensations.
25. \_\_\_\_ I'll try anything once.
26. \_\_\_\_ I like sports and games in which you have to choose your next move very quickly.
27. \_\_\_\_ I would enjoy water skiing.
28. \_\_\_\_ I quite enjoy taking risks.
29. \_\_\_\_ I would enjoy parachute jumping.
30. \_\_\_\_ I welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional.
31. \_\_\_\_ I would like to learn to fly an airplane.
32. \_\_\_\_ I sometimes like doing things that are a bit frightening.
33. \_\_\_\_ I would enjoy the sensation of skiing very fast down a high mountain slope.

1 = (*Agree Strongly*) 2 = (*Agree Somewhat*) 3 = (*Disagree Somewhat*) 4 = (*Disagree Strongly*)

34. \_\_\_\_ I would like to go scuba diving.
35. \_\_\_\_ I would enjoy fast driving.
36. \_\_\_\_ I generally like to see things through to the end.
37. \_\_\_\_ I tend to give up easily. (R)
38. \_\_\_\_ Unfinished tasks really bother me.
39. \_\_\_\_ Once I get going on something I hate to stop.
40. \_\_\_\_ I concentrate easily.
41. \_\_\_\_ I finish what I start.
42. \_\_\_\_ I'm pretty good about pacing myself so as to get things done on time.
43. \_\_\_\_ I am a productive person who always gets the job done.
44. \_\_\_\_ Once I start a project, I almost always finish it.
45. \_\_\_\_ There are so many little jobs that need to be done that I sometimes just ignore them all.
- (R)

(R) Indicates items that are reverse scored.

Appendix F  
Demographic Questions

## Demographics

Age: \_\_\_\_\_

What is your ethnicity? Check all that apply.

- a. American Indian or Alaska Native \_\_\_\_
- b. Asian (including Indian subcontinent and Philippines) \_\_\_\_
- c. Black or African American (including Africa and Caribbean) \_\_\_\_
- d. Hispanic or Latino (including Spain) \_\_\_\_
- e. Native Hawaiian and Other Pacific Islander \_\_\_\_
- f. White (including Middle Eastern) \_\_\_\_
- g. Other (please specify) \_\_\_\_\_
- h. Prefer not to respond

What is your biological (birth) sex?

- a. Male \_\_\_\_
- b. Female \_\_\_\_
- c. Intersex \_\_\_\_
- d. Do not wish to disclose \_\_\_\_

Are you Transgender?

- a. Yes \_\_\_\_
- b. No \_\_\_\_
- c. Do not wish to disclose \_\_\_\_

Are you currently practicing, competing, and/or participating in your particular sport(s), regardless of current season; off-season, pre-season, and/or mid-season?

Yes \_\_\_\_

No \_\_\_\_

a. If yes, please list the sport(s) you are currently involved in: \_\_\_\_\_  
\_\_\_\_\_

Check the sport(s) level you currently compete at:

b. Varsity \_\_\_\_

c. Club \_\_\_\_

d. Recreational \_\_\_\_

e. Professional \_\_\_\_

f. Other \_\_\_\_\_

Have you received a past concussion diagnosis from a medical professional?

a. Yes \_\_\_\_

b. No \_\_\_\_

c. I do not recall \_\_\_\_

If yes, how many medical diagnoses of concussions have you been given? \_\_\_\_



\*Below is a functional definition used when diagnosing a concussion.

Definition of a concussion: A concussion is a blow to your head that causes a variety of symptoms that may last for a short period of time, such as a few plays or minutes of a game, or a longer period of time. These symptoms may include and of the following:

- Headache
- Difficulty concentrating or focusing
- Feeling slowed down
- Dizziness or balance problems
- Nausea
- Fatigue
- Feeling dazed
- Drowsiness
- Forgetting things
- Sensitivity to light
- Loss of balance
- Sensitivity to noise
- Blurred vision

\*IMPORTANT:

A) You can have a concussion without being “knocked out” or unconscious.

B) Feeling “Dazed” IS a concussion.

Based on the above criteria for concussions, do you think you may have received a concussion, but it was not diagnosed and/or you did not seek medical treatment?

a. Yes \_\_\_\_

b. No \_\_\_\_

## Appendix G

### Self-report Criminal History

### Self-report Criminal History

\*Please indicate the response to each of the following questions with a (X)

and follow the directions for each of the following answers.

1. *Prior* to your first concussion, have you ever been arrested, charged, and/or convicted for a crime classified as violent? Examples include: assault, aggravated assault, armed robbery, hate crimes, rape, and sexual assault.

Yes\_\_\_

No\_\_\_

Do not wish to disclose \_\_\_

2. *Since* your first concussion, have you ever been arrested, charged, and or convicted for a crime classified as violent? Examples include: assault, aggravated assault, armed robbery, hate crimes, rape, and sexual assault.

Yes\_\_\_

No\_\_\_

Do not wish to disclose \_\_\_

3. Do you think that any of your aggressive, impulsive, and/or violent behavior has been affected, caused, and/or influenced by your concussion(s)?

a. Yes \_\_\_

b. No \_\_\_

c. I do not know \_\_\_

d. Maybe \_\_\_

3a. Please explain, \_\_\_\_\_

4. Any comments about above question? \_\_\_\_\_

Appendix H  
IRB Approval Forms

**WESTERN WASHINGTON UNIVERSITY**  
**Office of Research and Sponsored Programs**

**MEMORANDUM**

**TO:** Jason Haddix, Kinesiology – Sport and Exercise Psychology  
**FROM:** Janai Symons, Office of Research and Sponsored Programs  
**DATE:** 2/8/2017  
**SUBJECT:** Institutional Review Board– Exemption Research Approval

Thank you for submitting a research protocol regarding your human subject research EX17-059 “Aggressive and Impulsive Behavior in Concussed Athletes” for review by the Institutional Review Board (IRB).

*Approval:* The IRB has reviewed the materials you submitted and found the project described falls into Category #2: research involving survey or interview procedures. Although the research qualifies for exempt status under 45 CFR §46, the investigators still have a responsibility to protect the rights and welfare of their subjects, and are expected to conduct their research in accordance with the ethical principles of Justice, Beneficence, and Respect for Persons, as described in the Belmont Report, as well as with state and local institutional policy. All students and investigators collecting or analyzing data must be qualified and appropriately trained in research methods and responsible conduct of research.

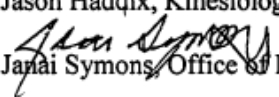
*Determination Period:* An exempt determination is valid for five years from the date of the determination, as long as the nature of the research activity remains the same. If the involvement of human participants changes over the course of the study in a way that would increase risks, please submit a revised protocol.

*Problems:* If issues should arise during the conduct of the research, such as unanticipated problems that may increase the risk to the human subjects or change the category of review, notify the Research Compliance Officer promptly. Any complaints from subjects pertaining to the risk and benefits of the research must be reported to the Research Compliance Officer.

If you have any questions, feel free to email me at [janai.symons@wwu.edu](mailto:janai.symons@wwu.edu).

**WESTERN WASHINGTON UNIVERSITY**  
**Office of Research and Sponsored Programs**

**MEMORANDUM**

**TO:** Jason Haddix, Kinesiology – Sport and Exercise Psychology  
**FROM:**  Janai Symons, Office of Research and Sponsored Programs  
**DATE:** 3/13/2017  
**SUBJECT:** Institutional Review Board– Exemption Research Modification Approval

Thank you for submitting a research modification regarding your human subject research EX17-059 “Aggressive and Impulsive Behavior in Concussed Athletes” for review by the Institutional Review Board (IRB).

*Modification Approval:* The IRB has reviewed the materials you submitted and found the project described falls into Category #2: research involving survey or interview procedures. Although the research qualifies for exempt status under 45 CFR §46, the investigators still have a responsibility to protect the rights and welfare of their subjects, and are expected to conduct their research in accordance with the ethical principles of Justice, Beneficence, and Respect for Persons, as described in the Belmont Report, as well as with state and local institutional policy. All students and investigators collecting or analyzing data must be qualified and appropriately trained in research methods and responsible conduct of research.

*Determination Period:* An exempt determination is valid for five years from the date of the determination, as long as the nature of the research activity remains the same. If the involvement of human participants changes over the course of the study in a way that would increase risks, please submit a revised protocol.

*Problems:* If issues should arise during the conduct of the research, such as unanticipated problems that may increase the risk to the human subjects or change the category of review, notify the Research Compliance Officer promptly. Any complaints from subjects pertaining to the risk and benefits of the research must be reported to the Research Compliance Officer.

If you have any questions, feel free to email me at [janai.symons@wwu.edu](mailto:janai.symons@wwu.edu).

Appendix I  
Initial Contact Emails

Dear X,

My name is Jason Haddix, and I am a graduate student at Western Washington University. I am currently pursuing a Master's degree in sport and exercise psychology in Western's Kinesiology program. This email is regarding my thesis project, which involves the participation of competitive athletes. I am looking to find current athletes, from both men's and women's sports, to complete an anonymous self-report survey. The goal of my research is to improve information regarding emotional states in high performing athletes and the differences in emotional behavior following a concussion or apparent head injury.

If you agree to have your athletes participate, this email contains a link to the research survey. Please forward this email to your coaching staff or to the athletes directly. Answers will be **anonymous** and not tied to particular universities in any way.

The athlete's participation is completely voluntary, and the athlete has the choice to end the survey at any time. Although there are no direct personal benefits from completing this survey, the athletes can help increase awareness of emotional behavior relating to concussions by answering the questionnaires.

I hope that you see the importance of this research and its relation to athletes' mental and emotional wellbeing. I thank you for your time and hope that you choose to represent your athletes in the survey.

Thank you,

Jason Haddix  
haddixj@wwu.edu  
Graduate student, Sport and Exercise Psychology  
Western Washington University  
Supervisor:  
Dr. Linda Keeler, CC-AASP  
[Linda.keeler@wwu.edu](mailto:Linda.keeler@wwu.edu)



Dear X,

My name is Jason Haddix, and I am a graduate student at Western Washington University. I am currently pursuing a Master's degree in sport and exercise psychology in Western's Kinesiology program. This email is regarding my thesis project, which involves the participation of competitive athletes. I am looking to find current athletes, from both men's and women's sports, to complete an anonymous self-report survey. The goal of my research is to improve information regarding emotional states in high performing athletes and the differences in emotional behavior following a concussion or apparent head injury.

If you agree to have your athletes participate, this email contains a link to the research survey. Please forward this email to the club coaching staff, team captains, or to the athletes directly.

Answers will be **anonymous** and not tied to particular universities in any way.

The athlete's participation is completely voluntary, and the athlete has the choice to end the survey at any time. Although there are no direct personal benefits from completing this survey, the athletes can help increase awareness of emotional behavior relating to concussions by answering the questionnaires.

I hope that you see the importance of this research and its relation to athletes' mental and emotional wellbeing. I thank you for your time and hope that you choose to represent your athletes in the survey.

Thank you,

Jason Haddix  
haddixj@wwu.edu  
Graduate student, Sport and Exercise Psychology  
Western Washington University  
Supervisor:  
Dr. Linda Keeler, CC-AASP  
[Linda.keeler@wwu.edu](mailto:Linda.keeler@wwu.edu)